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TESTING DIRECT-CURRENT DYNAMOS.

The beautiful and instructive method of testing direct-current dynamos, first proposed by Dr. John Hopkinson and later modified in various ways for meeting various conditions, has rendered important service in the study and development of electrical machinery. Although, as first applied, it was not very convenient, since it involved the measurement of mechanical power, this really was of small consequence, since the power thus supplied made up merely the losses taking place in the two machines and a considerable error might be made in its determination without seriously affecting the accuracy of the final result. An instructive feature of this method is the fact that a large amount of power can be circulated through the two machines under test, although the engine which brings about this circulation is itself doing but little work. The test seems to the student at first analogous to a man's lifting himself by his boot-straps, but the analogy is only complete by assuming that the first man is attached by a rope running over a pulley to a second of similar weight, and a boy stands by to pull on the rope and overcome the frictional losses of the connecting system.

This test in some of its modified forms is conducted more conveniently, but as applied to direct-current machinery it has called for a supply of power and two similar dynamos, or motors, and in some of the more accurate methods of carrying it out a third auxiliary machine is employed. As applied to alternating-current machinery the test has also been of great value, and with apparatus of this kind it is more easily applied because, due to the character of the construction of alternators, it is generally possible to run one section of the machine as a generator and the other as a motor, a second machine not being necessary.

Until recently we have not seen any method of applying this test to a single direct-current dynamo, but in the ELECTRICAL REVIEW for March 28 was given a brief description of a method devised by A. Kolben. A similar method of applying the test has been employed, also, by Dr. W. Lulofs, at Birmingham University, England. This method, in brief, consists in applying to a four-pole dynamo a current drawn from a storage battery, this being passed in at and drawn out from diametrically opposite brushes, the other pair of brushes being short-circuited. Then, by slightly weakening one pair of adjacent poles and strengthening the other, half of the dynamo acts as a motor and the other as a generator. A slightly better arrangement is obtained when two diametrically opposite poles are maintained at the same magnetic strength while one of the remaining pair is weakened and the other strengthened. This method is ap-

plicable only to machines having a number of poles divisible by four. In this method of applying the tests it is obvious that the different parts of the machine will be loaded differently, and hence the conditions will not be entirely normal. The losses will, therefore, probably be slightly different from what they would under actual operating conditions. Moreover, there is a possibility of sparking at the commutator. However, since the total losses of the machine will hardly be more than ten or fifteen per cent of the total power, a fairly satisfactory idea of the efficiency may be secured by this method.

A somewhat different method of applying the circulating test to a single direct-current machine has been devised by Mr. S. P. Smith, and is described briefly in the *Electrician* (London) for March 20. In this the coils of all the north poles on the machine are connected in series, as are also all the south poles. Then one or the other of the exciting circuits is reversed so as to make all the poles of similar sign. Such an arrangement should give rise to no flow of current in the armature if short-circuited, provided everything be symmetrical; but if the excitation of one series of poles be changed, an unbalanced condition arises, causing a current to flow in the short-circuited armature. In this way full-load current may be produced, giving rise to a proximity of full-load copper losses. Commutation, however, will probably be poor on account of the weak field, and, of course, the core losses will be absent and must be determined in some other way. If a commutating-pole machine should be tested it ought to be possible to secure actual commutating conditions during the test, but when this is not the case, Mr. Smith suggests that the operation of the commutator under full load be examined by disconnecting all the brush-holders and sending a full-load current from some external source in at one brush and drawing it out at another of similar sign, taking care, of course, to secure as equal distribution of current through the armature as possible. With this arrangement one brush will be working under normal conditions and, with normal excitation, its operation can be examined. The other will, of course, be under abnormal conditions and may even require adjustment one way or the other to prevent sparking. Mr. Smith states that this arrangement gives a very satisfactory idea of the behavior of the machine under normal full-load excitation, and also gives an idea of the heating. The latter arrangement is applicable only to machines without equalizing connections in place.

The same limitations as are applicable to the Hopkinson test when applied to two independent machines apply, in general, to the modified methods for testing one machine, and in these cases additional limitations may be introduced due to the commutating conditions. In such methods of testing two machines a compromise is made, because the two machines, or the two halves of one machine, are not working under the same conditions; hence, it is not correct to assume that the losses in both are identical. But when testing a single machine no division of the losses is called for.

For many purposes the comparatively small error made by the assumption that the losses are equal is entirely negligible, and when the power available is not sufficient to load fully the machine to be tested, or when the testing involves the loss of a great deal of energy, such, for example, as heat runs in the shop, the method is invaluable; but for tests conducted in order to demonstrate that a contract has been fulfilled, the actual full-load test under normal conditions should be made. The purchaser does not want to know what the machines would do under special conditions approximating the normal, but what its performance will be when in actual operation. Hence these modified Hopkinson methods, while valuable for the laboratory, are not likely to be adopted for actual performance tests.

A PLEA FOR A LIBERAL EDUCATION OF ENGINEERS.

Discussions of engineering education have been frequent of late, though in a good many instances but little of real value has been contributed to the subject. They, however, often bring to light some ideas worthy of comment. Following the reading of a paper on college and apprentice training, recently, before the American Society of Mechanical Engineers, Mr. Bassett Jones, Jr., urged a broadening of the course. Mr. Jones said under the terms of the Morrill Land Grant Act, the institutions which are thus founded are intended "to promote the liberal and practical education of the industrial classes," and he thought that this unfortunate bifurcation, made unintentionally, has become an established fact, as colleges for the inculcation of a so-called "liberal education" have, both in meaning and results, become distinct from the technical schools providing specialized education.

Mr. Jones says that a liberal education is practical when it gives the student an altruistic aim and purpose in life, regardless of the particular field to which his energies are devoted. A technical education that is not liberal in this sense is not practical. He thinks that the time is ripe for us to give a broader meaning to the term "technical," when used in connection with education, than that generally applied to it by public opinion. He thinks the so-called "liberalizing" studies should not be made separate from professional studies, but connected with them in every possible way. Political and social economics, for instance, have been deeply affected by the advance of science and engineering. The engineer has, also, been the prime maker of modern history, and hence these topics should be accentuated in schools of technology and more attention should be paid to the history of engineering, a subject which is to-day sadly neglected. Another defect of the present system is, according to Mr. Jones, the lack of interest of the teacher in those studies which he is not conducting personally. He is apt to specialize too much in his own field and neglect the relations between his subjects and the others that the student is also mastering.

As one means of overcoming in part some of these defects, Mr. Jones asks whether it is not possible to require the student to devote at least three of the four months of his vacation to actual money-making labor, to the mutual benefit of his college and employer. The advantage of this method is evident. He

gains something which no school can provide, a sound judgment, without which no man is worth his salt. Moreover, this experience would free the student's mind from the idea that a theoretical man is one who lacks definite experience in the limitations of fact, while a practical man is one who lacks education in the development of ideas.

The method suggested by Mr. Jones is being tried both in this country and abroad. The University of Cincinnati, while not following exactly the procedure which he has in mind, gives the student actual shop experience at the same time he is learning his principles and theory. In England, also, various ways have been proposed for meeting the needs, though over there the necessity seems to be greater in one way, at least, since the shops of the English schools are not usually as large and well equipped as those in this country. One of the foreign plans is to give favored apprentices a certain number of hours off a day, during which they attend classes. Others make allowance for work at night, while at least one of the universities over there has a system by which its students work in the shops during the vacation periods. The reports of these various methods seem to be fairly satisfactory in accomplishing what is sought, but none of them solves completely the problem of giving a general engineering education. The technical school is to-day trying to fill two demands: there is the larger body of students who want a brief course in applied science sufficient to enable them to reach a fairly satisfactory position; and there is a smaller class which is demanding a broader and more extended training. The latter are, in a way, provided for by the post-graduate technical courses, but if it were known beforehand which students intended to give six, instead of four, years to their college course, a considerable change in the course of studies which they take could be made with advantage. Non-technical studies could be, with profit, taken up in the earlier years, and the man thus given a broader view of society. The scientific courses could be laid out more satisfactorily and the interrelations between all the various studies made more definite. It is these men who should be instructed in political and social economics, history and other liberal studies. And it seems worth while digressing here for a moment to point out also the desirability of having those who specialize in such subjects as political and social economics and history gain some idea of the aim of the engineer and the view he takes of the problems of civilization.

It is not impossible, indeed it seems likely, that these two demands on the technical school may result in a division of the labor. The so-called "industrial," or trade, school, by a short extension in its course, could very well meet the needs of the large class of men who take the technical courses in the engineering college. This would leave the advanced courses free to be laid out in the most satisfactory manner for training the leaders. They might be conducted in technical, or scientific, schools as seemed most desirable. In fact, with this division of the labor, the advanced technical and the strictly scientific courses might be conducted by a single faculty without much difficulty.

SHOULD THE MANAGING ENGINEER OF A POWER PLANT HAVE A MECHANICAL OR AN ELECTRICAL TRAINING?

There has been some discussion of late, particularly in the English papers, of the propriety of placing an electrical engineer in charge of a power or lighting plant. This has been provoked by the recent accident at the Greenwich, England, power station, where a defective thermal storage vessel exploded with some damage. It is said by those who object to the operating engineer being an electrical man that had a competent steam engineer been in charge the defect in construction would not have been allowed in the first case, and the evidence of appending failure would have been noticed in the second. The accident would thus have been rendered very unlikely.

Commenting on this viewpoint, *Cassier's Magazine* says that the plan of putting an electrical engineer in charge of the power station, which seems to be customary in the municipal electrical plants of England, is not fair to the engineer because he may have had no opportunity to make a special study of steam appliances, and hence is not as competent to take care of them as would be one who had done so. On the other hand, it is said to be just as unfair to the steam engineer to make him responsible for the performance of the elaborate electrical equipment of a modern station, as the ordinary steam engineer has had as little opportunity to give it sufficient study. It was suggested, therefore, that the responsibility be divided between two men, one an electrical and the other a steam engineer.

This solution of the problem would be all right so far as each class of apparatus is concerned, but such a division of responsibility would be likely to lead to a conflict unless one man were made the head. If the electrical engineer is to say which generators are to run and which not, while the steam engineer is to say which engines are to be used, who is to decide when these two do not agree on the combined units. Obviously, there must be some one with authority to give the final word. The problem would be different if all the mechanical power could be delivered to and distributed from a single point, as is the electrical. But the conditions are quite otherwise.

The solution of the problem is to have one chief engineer, who is responsible for the entire operation of the plant, and under him there should be competent specialists, one for the electrical, and the other for the steam, end of the station. The chief engineer is, of course, responsible for the competency of his assistants, and if he does his duty he will give due consideration to their recommendations. With this arrangement it seems of small moment whether the chief be an electrical or a steam man. He should not be called upon to give up his time to the many little problems arising every day in the operation of a station. The best results are obtained when his efforts are devoted to perfecting his organization and dealing with such special cases as may come up. A man loaded down with a multitude of little matters has no time nor energy left for properly solving the big problems when they come up. Such an organization may not be within the means of a small station, but it should be required of all large ones.

The Work of the New York State Public Service Commission for the First District.

The Public Service Commission for the First District, New York state, has published a review of its work for the first nine months of its existence.

It has planned and had approved by the Board of Estimate and Apportionment routes for two new subways, to cost $82,000,000 in the aggregate; has perfected plans for one of them—the Brooklyn Fourth avenue line—and is now advertising bids for its construction. It has exercised its powers of regulation by issuing orders resulting in better and increased service on existing transportation lines and in satisfying complaints of citizens, particularly in regard to gas meters. The commission was given jurisdiction over practically all public service corporations except telephone and telegraph companies. The subjects which have demanded most of its attention since its organization may be divided into three general heads: new rapid transit lines, gas and electric light and power, and regulation of existing means of transportation.

It is estimated that at least $15,000,000 will be required to build the Fourth avenue subway in Brooklyn, which will run from the new Manhattan Bridge up Flatbush avenue and Fourth avenue to Forty-third street. It is expected that there will be a lively competition among contractors for this work. The contracts are to be let for six different sections, and under the recent ruling of the corporation counsel, one or more sections may be undertaken at once, according to the amount of money which the Board of Estimate will be able to devote to the project.

The plans for the Manhattan end of the Brooklyn subway loop, which is to connect the Brooklyn, Williamsburg and Manhattan bridges by a four-track subway, have been modified so that trains coming from Brooklyn may pass through this loop and back over another bridge without switching on the Manhattan side. The contracts for this work were let by the old Rapid Transit Commission, but by the changes made by the Public Service Commission the subway will be enlarged and many heavy grades avoided. It has also been decided to increase the dimensions of the subway so as to admit of the operation of ordinary railroad coaches through these tunnels. All future subways will have at least one foot more clearance between roof and ties than the present subway.

The commission has put into practical form the demand for an east side subway in Manhattan and the Bronx by approving a route which, beginning at the Battery, runs up Greenwich and Vesey streets and Broadway to Tenth street, thence to Irving place and Lexington avenue, and up Lexington avenue to the Harlem River. Passing under the Harlem River, the route divides in the Bronx into two branches, one going eastward to Westchester and Pelham Bay Park by way of the Southern Boulevard and Westchester avenue, and the other going northwest through Girard and Jerome avenues to Woodlawn Cemetery.

The commission has also laid out the route for the first crosstown subway in Canal street, which will connect with the Broadway-Lexington avenue line and stretch practically from river to river. The approval of the Board of Estimate and Apportionment has been obtained for both these projects, and the commission's engineers are now engaged in preparing plans, which will be submitted to the Board of Estimate early in the summer. The cost of the combined work is estimated at $67,000,000.

The work of testing gas meters has been taken up systematically and scientifically. A staff of inspectors has been organized, proper seals provided, and a regular system of inspection begun. During the first six months, or from July 15 to December 27, 1907, the commission tested in all 127,846 meters, of which 44,227 were new meters, 82,057 repaired and removed meters, and 1,562 meters tested on complaints of consumers. Of the 1,562 tested, 203, or thirteen per cent, were found to be correct; 211, or thirteen and one-half per cent, were less than two per cent fast (the limit allowed by law); 598, or more than 38.3 per cent, were two per cent or more fast, and 550, or 35.2 per cent, were slow. The average of the fast meters was 3.43 per cent fast; the average of the slow meters, 2.89 per cent slow.

For the three months ended March 31 the commission tested 81,681 meters, which, added to the total for the preceding six months, makes a grand total of 209,527 meters tested during the first nine months of the commission's life. Of the 2,805 complaint meters tested since January 1, 324 were absolutely correct, 1,820 were fast, and 661 were slow. The average percentage of fast meters was 3.4 per cent fast, and that of the slow meters, 2.3 per cent slow for the three months. In addition to this work the commission has now entered upon an investigation of the service given and the contracts made by electric light and power companies with private consumers. This investigation is now in progress before Commissioner Milo R. Maltbie.

New Westinghouse Plan.

A new plan for the solving of the difficulties under which the Westinghouse Electric and Manufacturing Company has been laboring since last fall, when it was placed in receivers' hands, has been formulated by a committee representing a majority of the merchandise creditors. This plan promises an earlier discharge of the receivers than that of the readjustment committee announced recently. It has the support also of Mr. Westinghouse and other large holders of stock and the readjustment committee will hold its plans in abeyance, collaborating with the creditors' committee in making the present plan a success. It is now planned to fund $7,919,000 of the floating debt by converting it into assenting stock. It is also proposed to raise $6,000,000 working capital by sale to the stockholders at par of $6,000,000 assenting stock. It is estimated that the company should, during the next five years, earn sufficient to pay all its fixed charges, seven per cent on the preferred stock, six per cent on the assenting stock, and create an annual surplus of at least $1,000,000.

Central Electric Traffic Association.

It is announced in Columbus, Ohio, that A. L. Neereamer, formerly an official of the Columbus, Delaware & Marion Electric Railway, has been appointed chairman of the Central Electric Traffic Association, effective April 15. This is a new proposition, the association having just completed its organization. It is similar to the Central Traffic and Freight Association of the steam lines. Mr. Neereamer's territory will embrace Ohio, Indiana, Illinois, lower Michigan, western New York and portions of Pennsylvania and Kentucky.

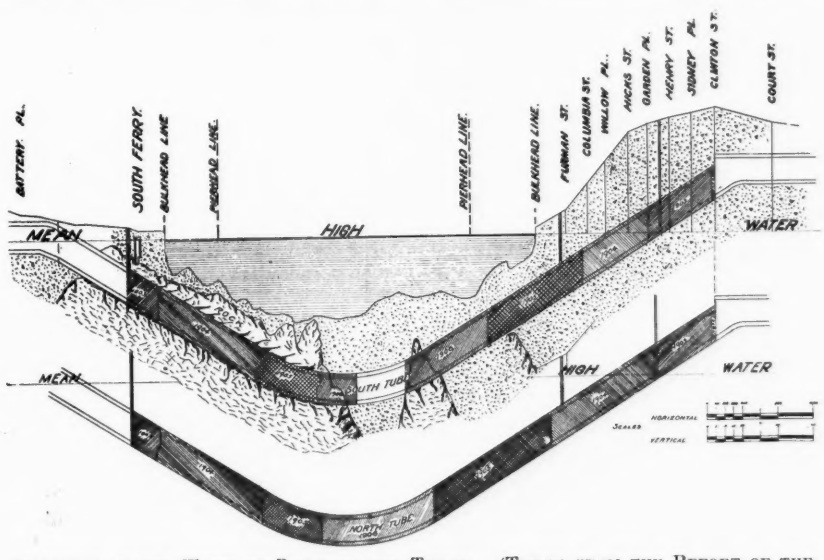
United States Telephone Company Declared Insolvent.

Vice-Chancellor Howell, at Newark, N. J., on April 3, decided that the United States Independent Telephone Company, of Rochester, N. Y., against which there was recently entered a deficiency judgment for $16,000,000 in the New York Supreme Court, is insolvent, and advised a decree that a receiver be appointed. The company is capitalized for $50,000,000.

The East River Tubes Connecting New York and Brooklyn.

A Description of the Construction of the Subaqueous Tunnels and the Electropneumatic Block Signaling and Interlocking System.

THE most recent addition to the rapid-transit facilities of the boroughs of Manhattan and Brooklyn, New York city, was put into operation on January 9, when the Interborough Rapid Transit Company sent its first train-load of officials and invited guests through the system of tubes which had been constructed from Bowling Green, Manhattan, to Borough Hall, in the borough of Brooklyn. Formal exercises commemorating the opening of these tubes were held at Borough Hall, in Brooklyn, the leading officials and prominent citizens taking part in the exercises on that day.



PROGRESS OF THE WORK OF BUILDING THE TUBES. (TAKEN FROM THE REPORT OF THE BOARD OF RAPID TRANSIT RAILROAD COMMISSIONERS, 1906.)

The history of these tubes dates from 1900. In February of that year the Board of Rapid Transit Railroad Commissioners, having completed the Manhattan subway contract for the city, directed its chief engineer to investigate and report as to the practicability and cost of extending the system to Brooklyn by means of a tunnel from South Ferry. Special legislation had to be undertaken, because, under the Rapid Transit Act of 1894, the jurisdiction of the board did not extend to the borough of Brooklyn. A bill was introduced and passed in the legislature, thus extending the jurisdiction of the board. This bill became a law in April, 1900, upon its acceptance by the city and its approval by the governor.

At the public hearings prior to the enactment of the bill, which were largely attended by representatives of various civic bodies, arguments were advanced principally in favor of two different routes, one *via* Joralemon street and Flatbush avenue to Atlantic avenue, in Brooklyn, and the other *via* Hamilton avenue to Bay Ridge. At the hearings it proved that the former route, which was the one adopted later on, had the support of the largest and most representative of these organizations.

One of the most important of the incidents characterizing the debate upon the preferential route was the offer by the Rapid Transit Subway Construction Company, the general contractor for the Manhattan subway, to bid for their construction and operation in the event of the tunnels being built along the Joralemon street route. Finally, on January 24, 1901, the Board of Rapid Transit Railroad Commissioners passed a resolution adopting the Joralemon street route, and authorized an application for the approval of the municipal authorities. There was further opposition, however, and it was not until June 1, 1901, that the necessary approval of the municipal assembly and the mayor was secured. Further than this, consents could not be secured from the owners of one-half in value of the property along the streets of the proposed route, and the matter had to be taken to the Supreme Court of the state of New York. After several hearings the commissions which were appointed by the Appellate Division to take testimony reported favorably to the court, which confirmed their findings in January, 1902. Consent had in the meantime been granted by the Secretary of War for the construction of the under-river portion of the route. The consents of the city departments of parks and docks had also been obtained. Plans and estimates had been prepared by the engineering department of the Rapid Transit Railroad Commission, and the first studies for the river portion were made with a view to building the tunnels in sections, sinking them into place and joining them together. This plan was found impracticable and was given up.

On June 12, 1902, the board adopted certain plans and forms of contract which had been prepared, and authorized advertising for bids. The contract was awarded to the Rapid Transit Subway Construction Company on the basis of the lowest bid, and this was executed as contract No. 2 on September 11, 1902. The contract price was $2,000,000, and was estimated to be one-fifth of the actual cost of construction. The work was sublet for construction in four sections by the general contractor. The river tunnel section was let to the New York Tunnel Company about the end of 1902.

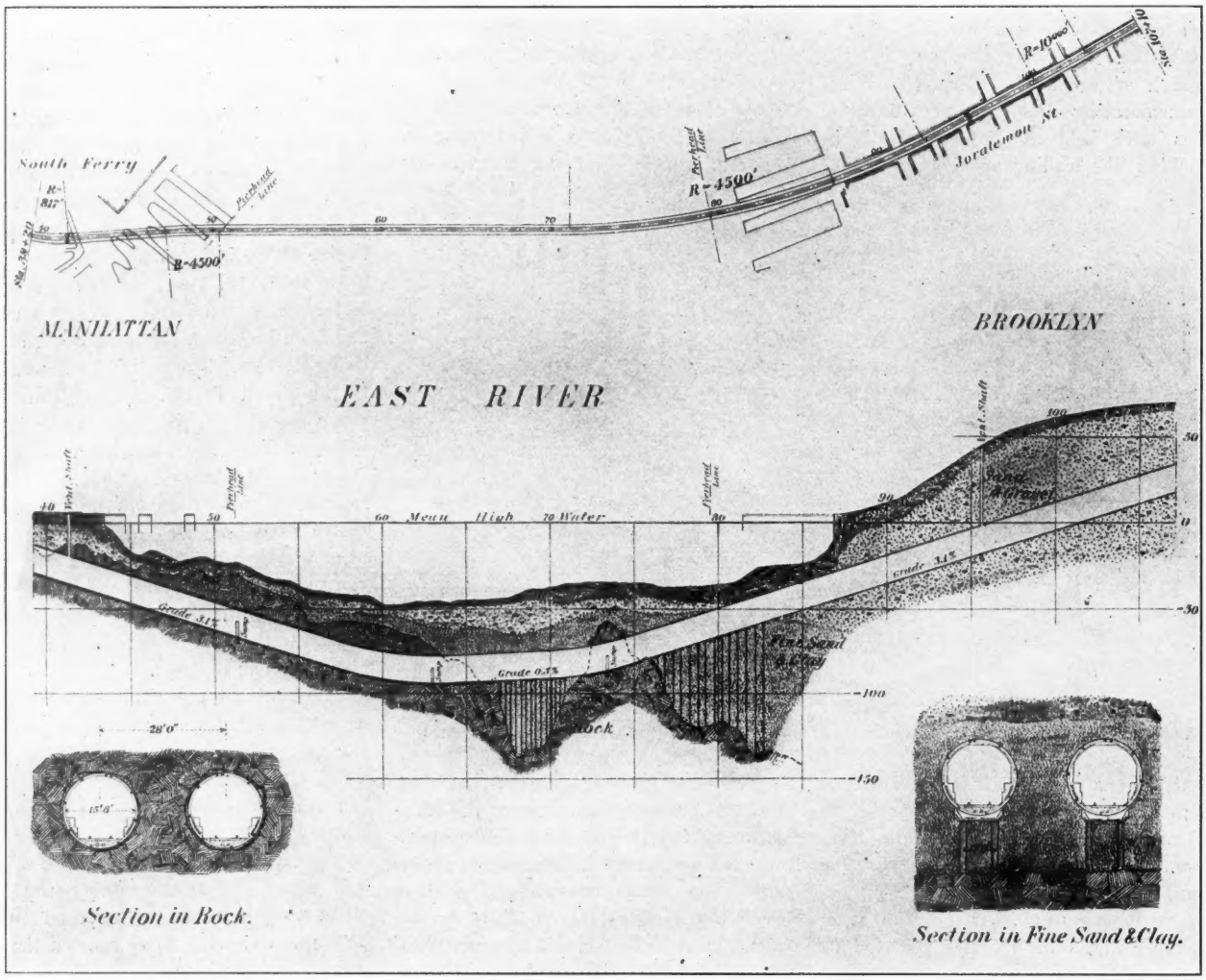
The route of the river tunnel section, as contracted for, begins at a point at the east side of Battery Park, opposite Pearl street, in the Borough of Manhattan, curving to the south and east through Battery Park, passing the bulkhead line on the river tangent at the foot of Whitehall street, continuing under the East River to the Brooklyn side, and ending at Clinton street. After construction began a deviation in the line of four degrees to the south was made near the Manhattan side, to allow for passing under the Brooklyn slip instead of under Pier 17 to the north, as originally planned.

The grade is 3.1 per cent downward on each side of the river, except for a short distance near the middle, where a 0.5 per cent grade upward toward Brooklyn was later introduced. This portion is joined to the steeper grades on each side by vertical curves of 10,000 feet radius. The tunnel is everywhere below the water level, except for about 700 feet at the east or Brooklyn end. The lowest

point reached by the tunnel is ninety-four feet below mean high water.

The tunnel consists of two circular single-track tubes of the usual cast-iron ring construction. These are fifteen feet six inches in internal diameter, and run side by side twenty-eight feet apart on centres, except under Joralemon street, Brooklyn, where this space is decreased to twenty-six feet.

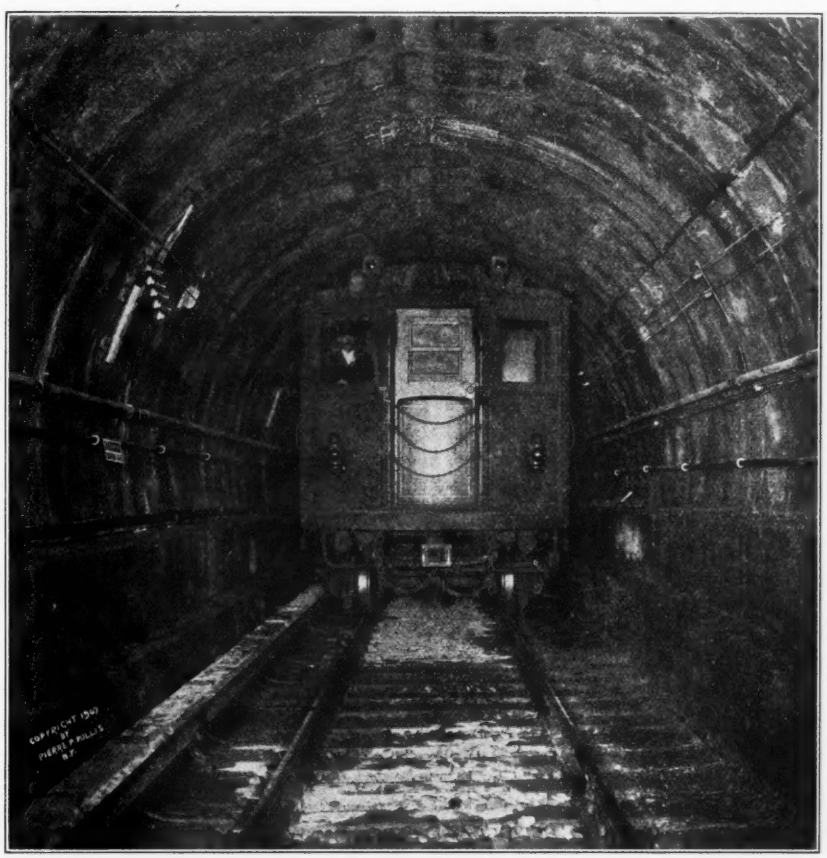
The accompanying illustration showing the profile of the tubes is interesting. For a distance of about 2,700 feet the material on the Manhattan side from the shaft east to the lowest point in the tunnel consists almost entirely of rock. About half-way from the low point to the Brooklyn side another stretch of rock about 400 feet in length is passed through. The rock is generally found to be a good character of mica schist and gneiss. For the remaining distance the material consists generally of sand of varying degrees of fineness. Under Joralemon street, and part way out in the slip between Piers 17 and 18, the sand is of ordinary coarseness and contains considerable gravel, cobbles and boulders of all sizes. Between the two rock formations, and east of the Brooklyn reef, the sand is extremely fine and contains a certain admixture of clay. This material is of the same nature as the quicksand encountered in foundations in the lower part of Manhattan Island, and shows the same tendency to run when disturbed.



Route and Sectional Elevation of East River Tube. Section Showing Construction Through Rock and also Through Fine Sand and Clay with Piling Reconstruction Driven to Bed-Rock.

The Manhattan shaft was located in the Battery Park enclosure, opposite South Ferry, and excavation began on March 4, 1903. This shaft measured fourteen feet by fifty-two in plan, taking in the headings for both tubes, and extended to the tunnel subgrade about forty-five feet below the surface. The shaft was sheeted on all sides with five-inch tongued-and-grooved sheeting, driven to the rock line, which was reached approximately half-way down. The headings for the north and south tubes were started east from the Manhattan shaft on April 9 and April 16, respectively. By the end of May, 1906, the headings reached a point near the end of the rock formation, where further progress was stopped temporarily to install shields. The first of the Brooklyn shafts—one for each tube—were located in Joralemon street, about 1,300 feet inland from the river, just west of Henry street, and about 700 feet from the end of the tunnel section. Excavation began on April 16, 1903. Each of these shafts was twenty feet by twenty-four feet in plan, sheeted with four-inch tongued-and-grooved sheeting, and extended sixty-five feet below the surface to the bottom of the tunnel. The first portion of the tunnel to be built in Brooklyn was a length of about 700 feet in each tube east from the shafts to the end of the section. The shield for the south tube was started east July 10, 1903, and reached the end of the section on January 11,

1904. The shield for the north tube was started east September 15, 1903, and reached the end of the section on January 16, 1904. The shields for the west headings were being equipped while the first pair progressed east. The south shield began to advance west from the shaft November 12, 1903, and the north shield February 2, 1904. After the bulkhead line was passed, caissons were sunk for new shafts, and these were put into use April, 1905, after which the original shafts were filled up. The new shields each measured nine by thirteen feet in plan, and were sunk thirty feet below the surface to the top of the tubes, to which they were then connected. The final meeting between the two headings took place between the two rock formations under the river. The north shields met on September 14, 1906, and the south shields met March 1, 1907. They were then dismantled, leaving the outer shells in place, after which the cast-iron lining was completed.



TRAIN IN NORTH TUBE, SHOWING THIRD-RAIL COVERING, DUCT-BENCHES, LIGHTING AND BATTERY MAINS, AND WORKMEN'S HAND-RAIL.

All tunneling operations were carried on in compressed air, except in the Brooklyn headings, where the tubes are above water level, and inside the bulkhead line at South Ferry, where leakage could be easily controlled by pumping. The working pressure varied from a few pounds to a maximum of forty-two pounds to the square inch above atmospheric pressure at the deepest section under the middle of the river. The tubes were divided into working chambers by brick or concrete bulkheads at intervals, into each of which were built two locks for passage of workmen and materials.

The tunnel shell is built up of flanged cast-iron plates bolted together by their flanges to form rings, each composed of eight segments and a key. The rings are fifteen feet six inches in internal diameter, twenty-two inches in length, one and one-eighth inches minimum thickness of metal, and seven inches to seven and one-half inches depth over flanges. All abutting surfaces are planed, the segments are bolted to the adjoining ones in the same ring with three one-inch bolts, and the rings are bolted to each other with forty-nine one-inch bolts in the circumferential flanges. The weight of each ring varies according to the location, the lighter ones, weighing 7,319 pounds each, being used in rock and above the water level in Brooklyn; and the heavier ones, weighing 8,332 pounds and 9,410 pounds each, being used under the river and for the rest of the work. The lining is grouted externally with equal parts of crushed dust and cement, and is made water-tight by calking with metallic lead in the recesses at the inner edges of the joints. The bolts and nuts are grommetted with a ring of hemp and red lead under plate washers.

During the construction of the tube many sensational reports found their way into the daily press, reflecting upon the work of the engineers and constructors. It was stated from time to time that deformations and variations had been discovered that would preclude the possibility of carrying out the tunnel work. After the tunnels were put in operation considerable capital was made by the sensation-mongers over some slight irregularities in the track and roadbed, and there has been a popular misapprehension as to the safety and stability of the tube system. The facts in the case are these: Deviations from the established grade were caused by the faulty control of the Brooklyn shields in a number of places between the Henry street shafts and the reef. These necessitated subsequent reconstruction of parts of the tunnel, especially in the north tube, to avoid too great an irregularity in the resulting grades, and this was successfully accomplished without materially interfering with the regular work of finishing the tunnel. The method adopted was simple, and consisted generally of removing the cast-iron segments in the lower half of the tunnel section and replacing them with new segments curved to an elliptical outline, so as to give more interior space at the bottom. For a short stretch in each tube on the Brooklyn side, where the earliest and greatest deviations occurred, the upper half of the tunnel lining was forced outward and upward by heavy hydraulic pressure sufficiently far into the surrounding soil to permit the construction of a new masonry roof providing increased clearance. The total length of tunnel reconstructed was 2,919 feet, of which 1,957 feet were in the north tube and 962 in the south tube.

Railroad corporations are sometimes charged with being without souls. However, in the case of the tubes running to Brooklyn, and, in fact, with regard to the entire system operated by the Interborough Rapid Transit Company, no expense or effort has been spared to render the service safe. The matter of the stability

of the fine sand on each side of the Brooklyn reef under the loads of moving trains having been questioned by officials of the Interborough company, it was considered advisable by them to provide some auxiliary means of support, such as piles reaching to rock, at intervals under the tubes where they passed through the material in question. While this view was not concurred in by the city engineers, experiments showed that the piles might be driven rapidly without materially delaying the completion, and this reconstruction work was allowed to proceed. Between the Brooklyn reef and the Manhattan rock formation in the middle-river section seventeen concrete pile bents were sunk under the north tube and fifteen similar bents under the south tube. Each bent consists of two piles about twenty inches in diameter, spaced seven feet apart transversely, and about thirty feet apart longitudinally of the tube. The piles were driven to depths ranging from five feet to forty feet. In the fine-sand formation east of the Brooklyn reef fifteen similar pile bents were sunk under each of the tubes. The pile bents in this section were spaced about fifty feet apart longitudinally, and extended to depths ranging from a few feet to seventy-five feet. In every case the piles were driven to hard material. To drive the piles it was necessary to remove the bottom plates of three rings below the spring line. These piles were then forced down by hydraulic jacking in sections with an outer steel casing filled with concrete reinforced by eight longitudinal rods. When a firm bearing was reached the piles were connected at the top by a broad reinforced concrete cradle, and the cast-iron lining was replaced.

After the cast-iron lining was made water-tight, the air pressure was removed and the interior of the shell lined with small-stone concrete mixed one to three to four. At the bottom, under the track, the concrete is brought eight inches inside the flanges and leveled at the ends of the ties to afford them a solid bearing. A concrete bench is built at each side of the track to enclose the tile ducts in each bench for the electric cables. At intervals of 300 feet the duct bench is omitted for a space of ten feet to leave a chamber for splicing the cables, and these chambers are covered with iron gratings.

The concrete lining of the roof is brought flush with the inside of the flanges of the cast-iron lining wherever the tunnel is in rock or under the land east of the bulkhead line in Brooklyn. For the remaining distance in soft material under the river the concrete lining is made sufficiently thick to cover the flanges three inches at the upper quarter points and further increased in thickness at the crown and spring line on each side by making the outline flat at these places. In this additional concrete there are embedded three circumferential one and one-quarter-inch round rods to each ring. These extend over the top arch 120 degrees. At the crown there are embedded sixteen longitudinal one and one-quarter-inch round rods in eighteen-foot lengths, connected by turnbuckles. In the bottom concrete for the same portion of the tubes there are embedded a corresponding number and arrangement of circumferential rods. On each side, lapping the circumferential rods at the top and bottom, are two one-inch-square rods to each ring, placed vertically. This reinforcement adds greatly to the resistance of the tunnel section to deformation. After the concrete lining was placed it was given a wash of cement grout as a finish to the surface. The finished condition of the tunnel section is well shown in the accompanying illustration, which also shows the head end of an approaching train.

Sumps for collecting the drainage of the tunnels are provided in concrete-lined cross-passages between the tubes at five places under the river. In these cross-passages there are also located the feeder switches and line telephones interconnecting the tube system with the signal towers and emergency stations of the operating company. Each sump is equipped with a Cameron single-acting pump operated by compressed air, and discharges through cast-iron pipes embedded in the concrete under the roadbed in each tube to permanent shafts on each side of the river. From this point the water is raised to the sewer by similar pumps of larger capacity.

There are two permanent shafts, one at South Ferry and the other at Willow Place, Brooklyn, which serve as ventilating openings, as well as connections for the drainage system and terminal racks for the power cables. The shafts are lined with reinforced concrete, including both tubes of the tunnel, and measure about fourteen feet by forty-five feet inside in plan. The shafts are equipped with fans driven by electric motors, and are so arranged that the air may be moved into or out of either end of the tubes. Under ordinary conditions adequate ventilation is provided by the movement of air caused by the passage of the trains through the tube.

The rails in the tube section weigh 100 pounds to the yard, and are spiked with tie plates to six by eight-inch yellow-pine ties spaced on eighteen-inch centres. The ends of the ties bear on the concrete lining, and the spaces between their ends are filled with concrete flush with the top. The rest of the space between and under the ties is filled with two-inch broken-stone ballast.

For the foregoing information we are indebted to Frederick C. Noble, division engineer of the Public Service Commission, under whose direction the tunnel work was carried out.

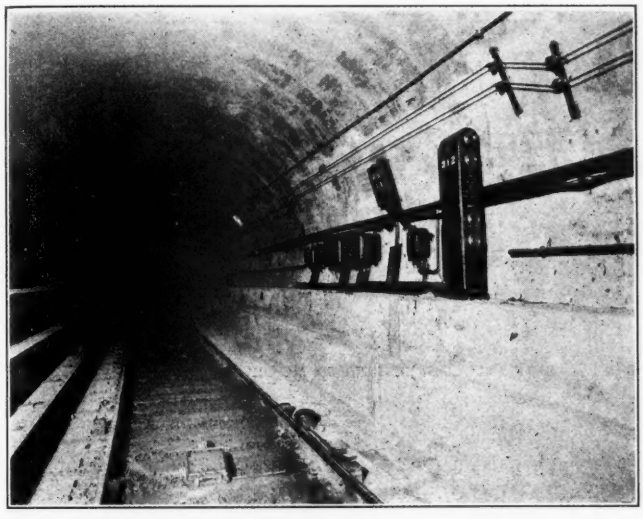
In order to provide for a maximum train movement through the tubes and insure absolute safety to traffic, an elaborate signal and interlocking system became necessary. This was worked out entirely by the signal department of the Interborough Rapid Transit Company and installed by the construction gang. The apparatus of the Union Switch and Signal Company was used throughout. The tracks entering the tubes to Brooklyn leave the New York subway just south of the Bowling Green station. The South Ferry loop tracks leave the southbound main-line track, curve around to the South Ferry station over the top of the Brooklyn tracks, and join the northbound main-line tracks at the south end of the Bowling Green station. The grade leaving the Bowling Green station for under the river is 3.1 per cent descending, and approaching the Borough Hall station from under the river is 3.1 per cent ascending.

The electropneumatic signaling and interlocking system installed in the tubes is a modification of the automatic block-signalling system installed in the Manhattan subway. One of the track rails is devoted to the signal-control current and the other to the propulsion return current. The use of the alternating-current track circuits involves the adaptation of specially designed alternating-current relays, which control the signal circuits and at the same time are entirely unaffected by direct-current disturbances.

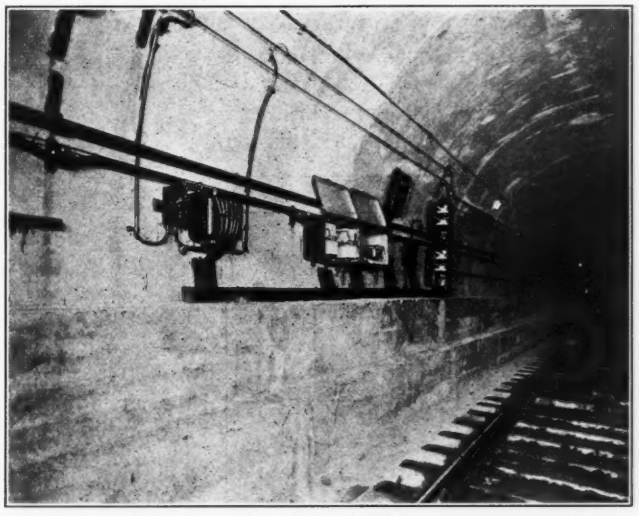
Contrary to the usual method of installing automatic block signals, which merely provide home and distant signals, with the block sections extending from home signal to home signal, the Interborough system includes a block signal and an overlap. Without the overlap, a train, in passing from one block section to another, will clear the home signals

for the section in the rear as soon as the rear of the train is beyond the home signal of the block in which it is moving. With the overlap system a train may stop at any point in a block section and still have the home signal which protects it at a safe stopping distance in the rear of the train. Another consideration which affects the use of the overlap is the use of automatic train trips. These trips, which applied by the automatic trip. The length of the overlap is determined by a careful series of tests of the braking power of the trains. From these tests curves are computed to determine the distance in which trains can be stopped at various rates of speed on ascending and descending grades and on level tracks. Speed curves are plotted for train operation over the entire line, showing at each point the maximum before reaching a train which might be standing at a signal in advance.

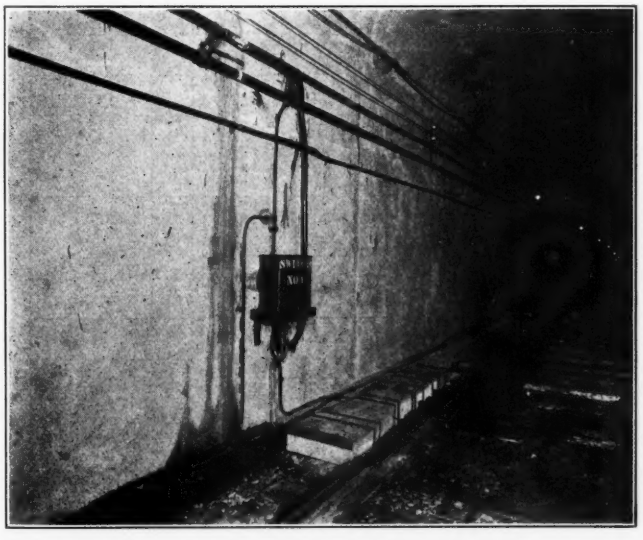
The track-signal circuits are supplied with alternating current by special high-voltage, sixty-cycle, alternating-current mains delivering current to the signal blocks at 550 volts potential. The current is transformed down at each block by a special double-secondary oil transformer. One coil of this transformer feeds the track



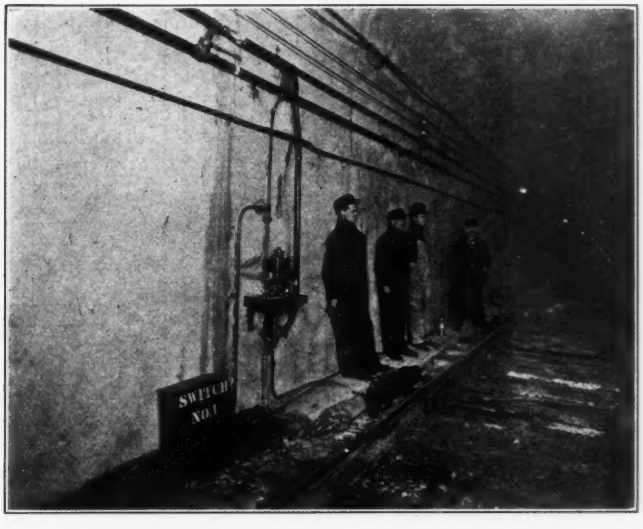
A Signal Block, Showing Signal Box, Valve-Box, Instrument Case, and Transformer. Notice the Automatic Trip at Right of Track and Trip Box Containing Counterweight Between the Tracks.



A Signal Block, Showing Transformer, Grid Resistances, Alternating-Current Relay and Signal Case. The Direct-Current Relays are Mounted Underneath the Lamps, the Circuits to which they Control.



Switch-Box Covered, Showing Method of Enclosing Switch Movement in Fireproof Board, Eliminating Possibility of Fire or Derangement from Lodgment of Rubbish.



A Typical Switch-Point, Showing Switch-Box Uncovered, Switch-Movement and Electric and Air Mains, Switch Movement Uncovered.

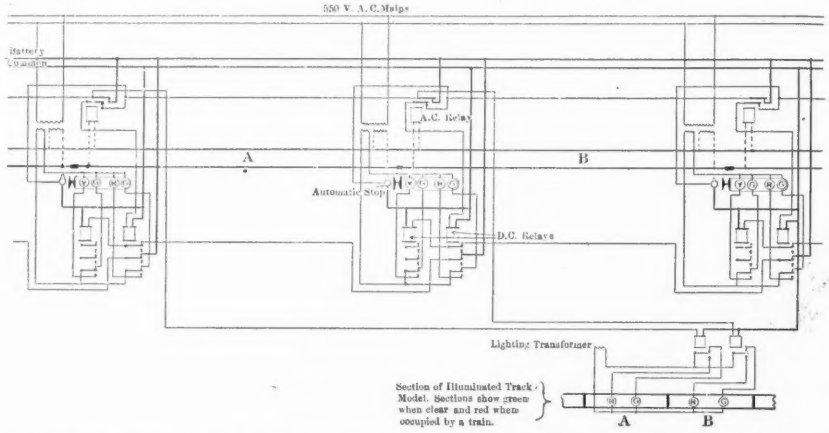
act by applying the air brakes automatically upon a train attempting to run past them, are placed at the home signals, and it is therefore essential that a stopping distance should be afforded in advance of the home signal to provide for stopping the train to which the brake had been possible speed. A joint consideration of the speed, braking efforts and profile of the road is used to determine at each and every point on the line the minimum allowable distance between trains, so that the train in the rear may be stopped by the automatic application of the brakes circuit and the other coil the signal-lamp circuit. Current is fed into each block at the end from which the passing train leaves it, the connections to the signal-control apparatus being made from the opposite or entering end of the block. The track connections at the signal end of the

block lead from the track circuit to alternating-current signal-control relays, which operate secondary connections in the various circuits of the signaling system. This relay apparatus, by means of its moving element, operates double contacts, so that when the block is clear and current is passing through it, two separate circuits are closed. One is the circuit leading to the automatic train stop at the entrance to the block in the rear, and the other circuit goes to a double-contact, direct-current relay which closes the circuit through the incandescent lamps behind the signal lenses. The effect of the magnets becoming inoperative due to the presence of a train in the block, and con-

SPECIAL SIGNAL FOR CUT OVERLAP SECTION.

sequent stoppage of the track-circuit return, is to set the signals to danger, making the system in effect the "normal-clear" type. The auxiliary circuit operates the distant or caution signal as the result of the setting of the home signal. When the home signal of a block is clear, current is passing through the control mechanism of the distant signal of the preceding block, thus holding it at clear also. When the home signal is thrown to danger, the current flowing in the auxiliary circuit is interrupted by a contact in the direct-current relay, which causes the distant signal to indicate caution.

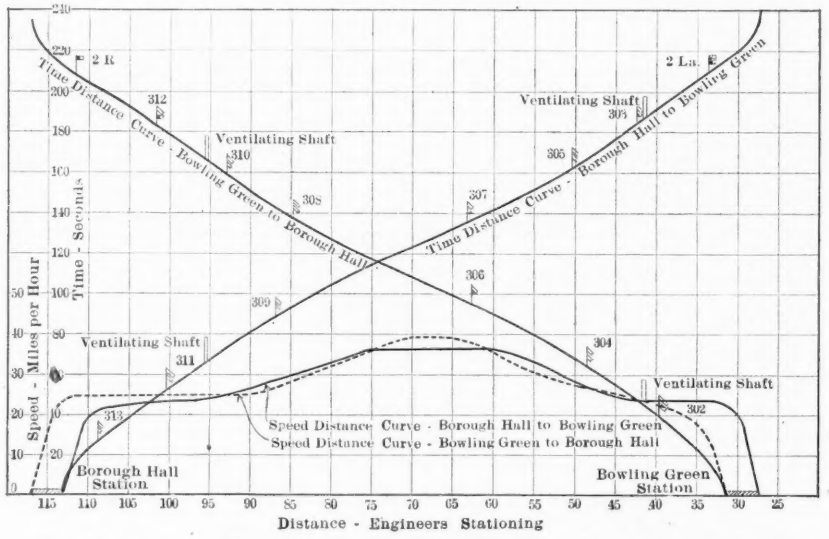
The apparatus installed at a block-signal station consists of the block signal, a transformer, a case for the track-circuit instruments, and the automatic trip valve box. The leads from one coil of the double-secondary transformer deliver current at ten volts for use in the track circuit. In the instrument case these leads pass through a non-inductive resistance of one ohm, which serves to prevent any



TYPICAL SIGNAL CIRCUIT LAYOUT AND CONNECTIONS TO BLOCK SECTION INDICATORS.

magnitude of current from flowing through these circuits in case of abnormal disturbing conditions in the propulsion return current. The resistance also prevents any excessive alternating current passing from the transformer when short-circuited by the presence of a train in the track circuit which it feeds. Two three-candle-power, sixty-volt lamps are installed in multiple behind each bull's-eye. The direct-current relays are installed in the signal box directly below the two sets of lamps, as may be seen very clearly from the accompanying illustrations. Current for the direct-current relays is taken from a storage-battery main which is fed by sets of sixteen-volt storage batteries installed in duplicate. These batteries are located in the interlocking towers, and are charged by motor-generators which take their current from the third rail.

In working out the signal problem, it was found that the greatest speed a train could acquire in passing under the river would be about sixty miles an hour, and that the speed at the top of the 3.1 per cent grade would be about twenty-two miles per hour. The signals were located so as to provide for a safe braking distance at the maximum speed of the train at the point where the signal was placed. Should a motorman disregard this signal the train would be brought to a stop before reaching a train in the next block in advance, due to the action of the automatic trip.

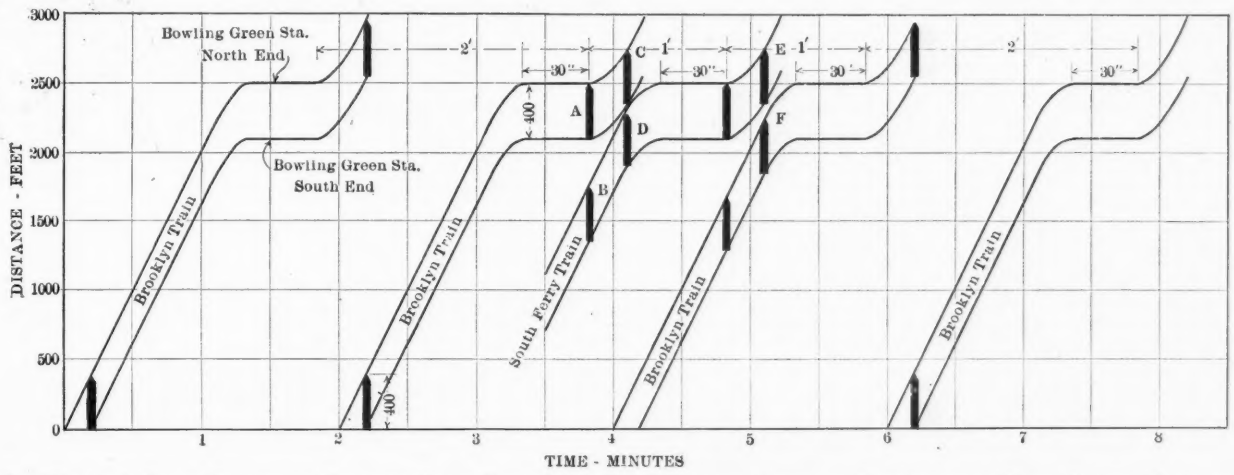


TIME-DISTANCE AND SPEED-DISTANCE CURVES, EAST RIVER TUBES, INTERBOROUGH RAPID TRANSIT COMPANY.

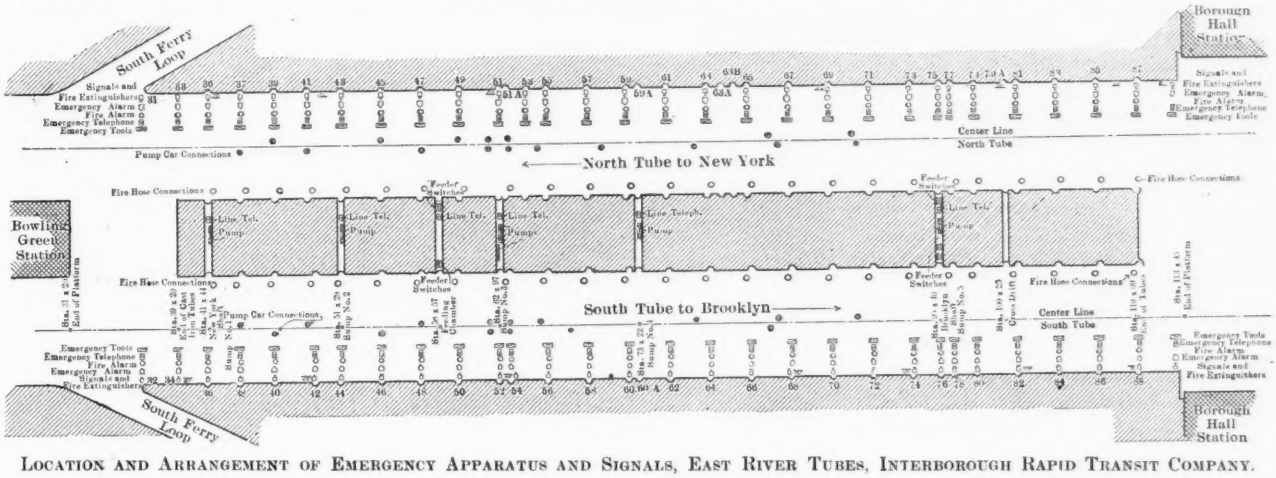
The signal study of the junction of the South Ferry loop track with the northbound track from Brooklyn at the south end of the Bowling Green station, at the

top of the 3.1 per cent grade, introduced some very interesting features. With a two-minute headway from Brooklyn, and a four-minute headway around the South Ferry loop, it was shown conclusively that in order to maintain good service it would be necessary for northbound trains from South Ferry to skip the Bowling Green station. It was necessary to do this also to reduce to a minimum the delays which would be occasioned by stopping trains from Brooklyn on the steep ascending grade, as every train so stopped requires from twelve to fifteen seconds to release brakes and get under way. The accompanying speed-distance and time-distance curves of runs from Bowling Green to Borough Hall, and from Borough Hall to Bowling Green, show the locations of the signals and also give a good idea of the relative speeds maintained over different portions of the run. The highest speed plotted on these runs was a little less than forty miles per hour, the whole distance from Bowling Green to Borough Hall, approximately 8,600 feet, being covered in 238 seconds. The run from Borough Hall to Bowling Green was made in about 240 seconds. The curves show the relative acceleration and retardation of the trains, and should be studied in connection with the profile herewith.

Another interesting curve shows the relative positions of front and rear ends of trains which would be necessary to operate the Brooklyn trains on a two-minute headway and the South Ferry trains on a four-minute headway, with a station stop of thirty seconds at Bowling Green. With a Brooklyn train in position A, just starting from the Bowling Green station, the following South Ferry train is at the same instant in position B, 350 feet from the rear of the Brooklyn train, and traveling at twenty-three miles per hour. When the Brooklyn train has reached position C, the following South Ferry train has reached position D, fifty feet from the rear end of the Brooklyn train, and traveling at nineteen miles per hour. When the South Ferry train has reached position E the following Brooklyn train is at the same instant at position F, 100 feet from the rear of the South Ferry train, and traveling at nineteen miles per hour. To reduce, as far as possible, the delays which this junction would occasion to trains from Brooklyn and the South Ferry loop in entering the Bowling Green station, there have been installed additional signals and stops with cut overlap track sections, which permits trains to approach toward the Bowling Green station immediately upon the preceding train starting from the station platform, without decreasing the factor of safety. It has been found that this arrangement makes a saving of about nine seconds to each train from the South Ferry loop, and of about twelve seconds to each train from Brooklyn, over what would be the case were the same method of control in vogue at this station as at other stations in the subway. The Interborough Rapid Transit Company has been trying to get permission to install this arrangement of signals at the approach to express stations in other parts of the subway for several months, but up to the present time the Public Service Commission has not granted the necessary authority. If these changes were made,



TIME-DISTANCE CURVE STUDIES OF RELATIVE TRAIN LOCATIONS, BOWLING GREEN APPROACH, INTERBOROUGH RAPID TRANSIT COMPANY.



LOCATION AND ARRANGEMENT OF EMERGENCY APPARATUS AND SIGNALS, EAST RIVER TUBES, INTERBOROUGH RAPID TRANSIT COMPANY.

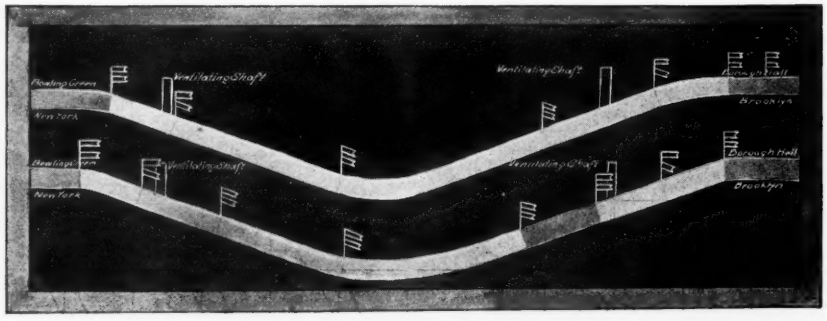
two additional express trains in each direction per hour could be added to the service.

In order that complete supervision of the trains in the tubes could be maintained from a single point, a system of visual indications was installed in the Bowling Green interlocking tower. This arrangement gives the operator at that point a miniature reproduction of the road between Wall street, Manhattan, and Borough Hall, Brooklyn. The operator is always aware of the exact location of all trains on this section of the system. He has under his jurisdiction the control of signals and stops at both entering ends of the tube, so that if a train, for any reason, should be delayed in either tube an unusual length of time, he can immediately prevent other trains from entering. Arrangements have also been made so that either track under the river can be used for traffic in a reverse direction in a safe manner. When used in this way the automatic trips are automatically cleared as the train approaches them, and the signal in advance goes to danger, locking out any train which could possibly approach.

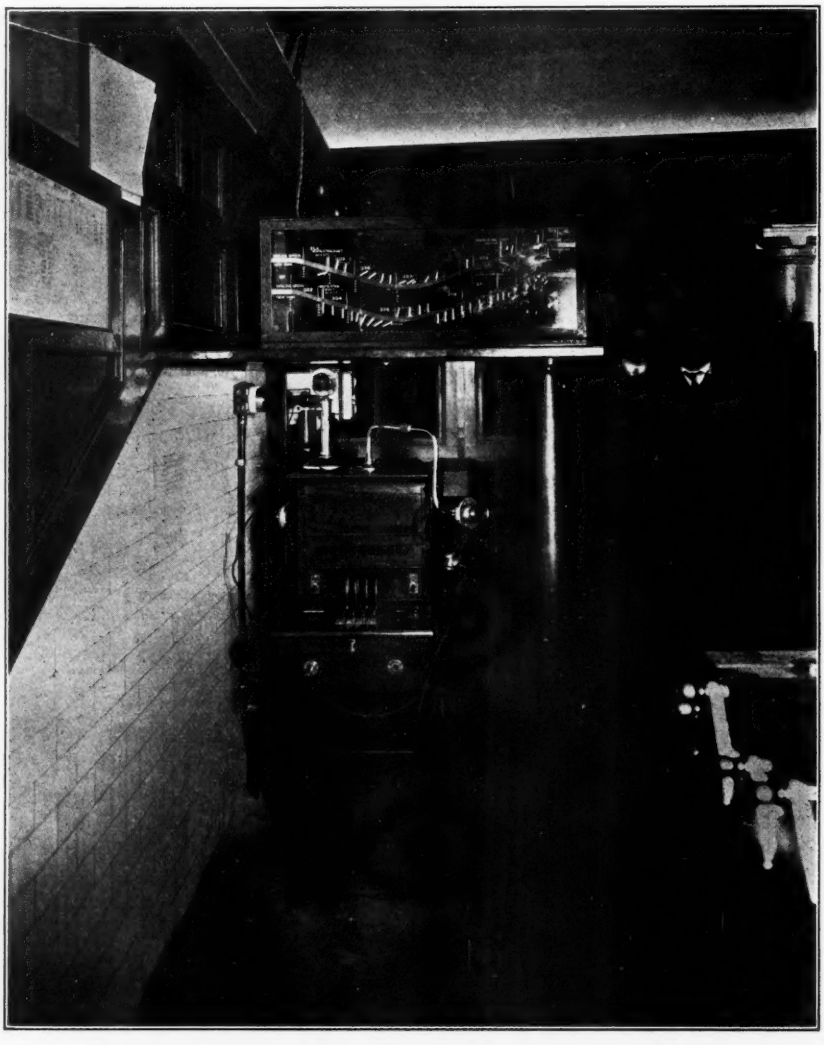
The accompanying illustration shows a partial view of the Bowling Green interlocking station. Here may be seen a twenty-drop intercommunicating telephone exchange, establishing connection with line telephones throughout both the north and south tubes. Mounted above the telephone switchboard is a cabinet four feet long, two feet high and one foot wide, with a black glass front, behind which are placed colored lights. On the face of this glass are two narrow strips about one-half inch wide, arranged to represent longitudinal sections of each tube. When there are no trains in the tubes these are green ribbons of light. Miniature signals in their correct location are placed on this model. When a train enters the tube at either end the green light is immediately changed to red for the block in which that train is moving. The red light follows the position of the train through the tubes. As soon as the train passes out of the block the green light is again displayed in its rear.

The operators in the signal tower, by means of double-pole, double-throw switches, can regulate the direction of the forced ventilation through the tubes. Control is also had at this station of the pumps supplying water pressure to the fire hydrants and also the sump pumps for the quick drainage of the tubes. The station is also equipped with Gamewell fire-alarm boxes and with a fire connection to fire headquarters.

The electropneumatic interlocking and switching arrangements at the Bowling Green tower include a cabinet placed in front of the operators manipulating the controller handles, which reproduces on a face-plate the tracks and cross-overs in this switching section. As trains approach from either direction a visual indication is given on this face-plate, and as the operator clears each switching point and arranges his tracks, this arrangement is reproduced on the face-plate. The con-troller handles rotate vulcanized-fibre cylinders, upon which are short-circuit-



THE VISUAL BLOCK-SECTION SIGNAL TRAIN INDICATOR IN THE BOWLING GREEN INTERLOCKING TOWER.



A PARTIAL VIEW OF THE BOWLING GREEN INTERLOCKING STATION.

ing copper bands similar to a drum-type controller. Proper electrical connections to the air valves at the switching points are made through wipe contact spring switch members, these connections closing circuits to the properly arranged relays.

In addition to the automatic block-signaling and electropneumatic interlocking system, both the north and south tubes are equipped with fire extinguishers, emergency alarms, emergency telephones, and emergency tools and fire-hose connections. This apparatus is distributed at certain distances throughout the length of the tubes, and is within convenient reach of the train crew should it become necessary to make use of any of the devices enumerated. In every way provision has been made for maximum train movement attended with a minimum possibility of danger to the passenger or derangement of the traffic.

For the information relating to the signaling system we are indebted to J. M. Waldron, signal engineer, Interborough Rapid Transit Company.

Important Decision Regarding Transfers on Street-Car Lines.

In the United States Circuit Court, on Tuesday, March 31, Judge Lacombe decided that transfers on some of the New York city car lines could be curtailed on and after April 11. The judge, in answer to a request from Receiver Frederick Whitridge, of the Third Avenue system, said it was obviously the duty of the receiver to curtail the transfer privileges in order to increase the revenues of the company. He advised the receiver to avoid any changes that might involve litigation, and specified the section of the road where the joint use of tracks involves free transfer rights for passengers. The court holds: "With these exceptions there seems to be no reason why the receiver should not discontinue all exchanges of transfers between the Forty-second street, Boulevard and St. Nicholas avenue lines and the lines of the Metropolitan Street Railway and the New York City Railway companies."

In connection with the receiver's application for release from the burden of transfers, there was presented a memorandum showing the extent to which fraudulent traffic in transfers has taken place. The statement follows:

"As indicative of the true situation in this connection, the following comparison is made between operating statistics for the year ended June 30, 1906, and the year ended June 30, 1907:

	1907.	1906.
Revenue passengers..	376,629,571	391,354,874
Transfer passengers..	194,765,342	178,639,866
Total passengers...	571,394,913	569,994,740
Miles operated.....	57,526,567	59,400,152
Receipts.....	$18,635,568	$19,381,681
Passenger receipts per car-mile.....	0.3240	0.3263

"In other words, while 1,400,000 more passengers were carried during the fiscal year 1907 than during the fiscal year 1906, the receipts and cash passengers were about four per cent less during the fiscal year 1907 than during the fiscal year 1906, and there were 16,000,000 more transfer passengers during the latter year than the year preceding it—an increase of about nine per cent.

"The transfer regulations and privileges prevailing during each year were practically the same and this decrease of nearly three-quarters of a million dollars in receipts was very largely due to the increase in the fraudulent use of transfers. It is impossible to conjecture how great is the actual annual loss to the company from this source, but it is probable that if this factor had been eliminated there would have been no necessity for the present receiverships of the various surface railroad properties on Manhattan Island.

"A comparison for the six months ended December 31, 1907, with the six months of the preceding year shows the following:

	1907.	1906.
Revenue passengers..	189,205,244	199,749,857
Transfer passengers..	104,304,715	99,071,219
Total passengers...	293,509,959	298,821,076

"The above figures indicate that during the last six months of the calendar year, 1907, there was a decrease in revenue passengers of more than five per cent when compared with the same period of the preceding year, but there was an increase in transfer passengers of more than five per cent when compared with the same period of the preceding year, while the percentage of transfer passengers to cash passengers has risen from 51.71 per cent (the average for the year ended June 30, 1907), to 55.13 per cent (the average for the six months ended December 31, 1907).

"In round figures 10,000,000 less revenue and 5,000,000 more transfer passengers were carried during the last six months of 1907 than during the last six months of 1906, and the average fare per passenger dropped from 3.29 cents (average for fiscal year 1907) to 3.16 cents (average fare per passenger for the six months ended December 31, 1907)."

Extensions of the Generating Plant at Wolverhampton, England.

The municipal electric supply system of Wolverhampton, England, has been so successful in disposing of its power that extensions have been necessary to meet the future needs. This system was first put in service in 1895, and then made use of the so-called Oxford system, distributing direct current at 2,000 volts to transforming substations. This system later was replaced by a three-wire, 440-volt system. At the present time but one of the old 140-kilowatt, 2,000-volt, direct-current machines is still in service, this being utilized for arc lighting. An interesting feature of the growth of this station is the increased use of power. In 1904 there were motors aggregating 500 horse-power attached to the system; at the end of last year the motor load was 1,960 horse-power. During this time the load-factor has increased from 17.3 to 20.5 per cent, and the generating costs, not including distribution and management, have fallen from 1.622 cents a kilowatt-hour to 0.942 cent. The total power load has overtaken the traction load, for during the first nine months of last year 1,298,000 kilowatt-hours were sold for power and 1,160,000 for traction. To meet the future demands the station has been extended and plans drawn for the installation of eight steam turbine units and sixteen boilers. At the present time two of these turbo-alternators, each rated at 1,000 kilowatts, have been installed, with condensers and two new boilers. The plans, however, call for 2,000-kilowatt sizes for all additional units. The saving in floor space secured by the use of steam turbine units is well illustrated in this station, as the space required for an equipment rated at 14,000 kilowatts in turbines and generators and the necessary boilers is but little more than that of the original engine and boiler house, which contains apparatus with an output of but 3,230 kilowatts.—*Electrical Engineering (London)*.

Building Trades Employers' Association Exhibit.

The Building Trades Employers' Association, after May 1, will establish a permanent exhibition at the Builders' Exchange Building, 30-34 West Thirty-third street, New York city, of the various articles, appliances and specialties used in the building industry. James J. Connor, 889 Broadway, is manager of the exhibition Department.

Electrical Notes from Great Britain.

(From Our British Correspondent.)

THE decision of the court in the litigation between the authorities of a Brighton church and the Brighton Corporation concerning an alleged nuisance and annoyance caused to worshippers and others in the church, from the "regular sound of the working of the motor-generator plant at the North Road works" of the city electricity supply department, has ended in a way with which no electrical men, and few others save the church authorities themselves, will quarrel. The church is situated in a poor locality, in which there are other works as well as the North Road station; not by any means, in the judge's opinion, a residential part of Brighton; the congregation had not diminished; no pecuniary damage was claimed; the incumbent was personally annoyed, but not sufficiently so to interfere with the performance of his duties. The sound was so insignificant that it was not noticeable during the singing or the playing of the organ, or when there was any other sound in the church. Judge Joyce thought that the sound might at times cause annoyance or irritation to certain sensitive persons, but it ought not to distract the attention of ordinary healthy persons. The law, he remarked, did not regard trifling inconveniences, and these things must be looked at from a reasonable point of view. The application of the church authorities for an injunction was therefore dismissed, but Judge Joyce, out of consideration for the church finances, presumably, offered a suggestion that the corporation should not insist upon its costs in the action being paid.

One may safely say that the matter that has been foremost in the minds of a large number of electrical engineers and manufacturers in this country during the past month has been the inquiry that has been in progress at Westminster, under the presidency of James Swinburne, concerning the proposed Home Office regulations relating to the application of electricity in workshops and factories. We referred to these regulations briefly when they were issued in draft form for consideration. Since then they have been subjected to the severest possible criticism from parties representing practically every department of the industry. When it is stated that something like 180 bodies were represented by either lawyers or experts, or both, as objectors to various clauses in the regulations, it may perhaps convey a general idea of the magnitude of Mr. Swinburne's task.

Various proposals have been made for international and other memorials to the late Lord Kelvin. A well-received movement is on foot for the setting up of a fitting memorial in Belfast, the city of Kelvin's birth. So far, the writer believes, the idea of an international scheme has not taken any tangible shape. The Institution of Electrical Engineers, of which his lordship was president at the time of his death, and of which he had for two previous periods occupied the presidential chair, has resolved to establish "Kelvin Lectures" on the lines of the "James Forrest" lectures of the Institution of Civil Engineers. The first lecture is to be delivered on April 30 by Professor Silvanus P. Thompson, than whom none could be found more suitable for handling such a subject as "Lord Kelvin" (which is announced) with full knowledge, with eloquence, with dignity and, if we may use the words, with real magnificence.

Once again the London power supply question is coming to the fore. There are three different proposals before Parliament, as we have already stated, and in two of them the existing companies are concerned. The president of the Board of Trade, Mr. Lloyd-George, has just advocated a conference between all the parties interested in the matter, and particularly in these three schemes, as the latter, as he points out, contain propositions which are so inconsistent as to render it an impossibility for all three to go through. The House of Lords sent down a recommendation to the Commons suggesting the reference of the three schemes to a joint committee of both houses, but Mr. Lloyd-George and the Commons do not agree to this. The president's view is that the different parties are approximating toward something like a reasonable settlement and a compromise, and he thinks that if the bills are first examined carefully by a committee of the Lords it will give time to the parties to consider proposals which will insure general consent. He admits that the problem is an extraordinarily difficult one, but he despairs of any settlement without some measure of agreement between all the parties engaged. If we read the present signs at all correctly there is a better prospect of a definite settlement being arrived at than there has been in any previous session of Parliament; there also seems good reason for believing that the rights of the existing companies in the metropolitan area and their pioneering difficulties in London electricity supply will not be disregarded.

There has just been installed at Wolverhampton in connection with the municipal electricity and tramways department a new generating plant comprising two 1,000-kilowatt, three-phase alternators (generating a 6,600-volt, fifty-cycle current) of the Electrical Construction Company type and manufacture, which are driven by Willans & Robinson turbines running at 1,500 revolutions per minute. The alternators are excited by two small motor generators of the four-pole type, with revolving field magnets. An Electrical Construction Company motor-generator set forms part of the new installation; it has a synchronous motor for three-phase, 6,000-6,600-volt supply, direct coupled to a 500-kilowatt, direct-current generator (460-500 volts, speed 60 revolutions). A 500-kilowatt motor-converter of Bruce Peebles's standard pattern, and an Electrical Construction Company extra-high-pressure switchboard, have also been installed, as well as two additional Babcock & Wilcox water-tube boilers, economizers, feed-pumps, etc. C. E. C. Shawfield is the city electrical and tramways engineer at Wolverhampton. The tramways have long been operated on the Lorain surface-contact system. The demand for power is growing very satisfactorily. The inauguration of the above new plant took place on March 16. The original machines in the station are direct-current generators driven by reciprocating steam engines. A special feature of the extensions is the adoption of the recently introduced Rees "Roturbo" feed-pump; this is claimed to be capable of giving the same service as three pumps which it replaces.

The Southend Corporation has lately had to consider claims against its electricity department consequent upon alleged nuisance. It is proposed to end the matter by purchasing certain land and houses concerning which the claim is made, at a cost of some $29,000.

The grievances of charge and shift engineers employed in electric generating and other stations in this country are constantly the subject of discussions in the technical press between writers representative of the various grades of men engaged in this class of service. There is a feeling just now—as there has been several times before, but without any practical result—that such officials might be able to raise their status and better their conditions and remuneration by banding together in an organized association. A movement having this object in view is on foot and is gaining ground, but whether it will have a more satisfactory issue (from the employés' point of view) than has followed earlier attempts it would be dangerous to prophesy, for the position of affairs is fraught with considerable difficulties. It is a fact, however, that there are a large number of central station workers in subordinate positions who do not regard the existing institutions or associations as meeting the needs of their particular case. What many of them appear to want is more in the nature of a trade (profession?) union to protect and advance their interests than an association for reading and discussing papers. So far as electricity works employés are concerned, the likely members of an organization are too widely scattered (save probably in London district) for the latter object.

The Newcastle-on-Tyne Electric Supply Company is constructing a tunnel costing $100,000 under the River Tyne to carry cables between Carville power station and Hebburn. By means of this tunnel the distance the cables have to be carried will be only 1,160 yards, a saving of 18,960 yards on the present system. The direct connection between Carville and the main cable system of the County of Durham Company at Hebburn will increase the effective capacity of the existing main cable north and south of the river. The Newcastle company has now arranged to put down a new power station costing $1,250,000 at Dunston, to enable it to cope with the steadily increasing demand for power on both sides of the river. Over 27,000 horse-power of new business in addition to that already connected has been contracted for. The site at Dunston has a 900-foot river frontage and 2,500 feet of railway line. The plant to be installed is to be of 30,000 horse-power, and the cost per horse-power is expected, with present experience, to work out rather less than at Carville.

ALBERT H. BRIDGE.

London, March 28.

Phase Relation of the Electric and Magnetic Components of Electric Waves.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In a rejoinder[1] to my criticism[2] of an article[3] on "An Ungrounded Closed Circuit for Receiving Wireless Signals," by Mr. G. W. Pickard, the latter has attempted to question what is known to every mathematical physicist and wireless expert as a fundamental fact—I may say an axiom—of electrodynamic wave motion in the ether. Mr. Pickard says: "Mr. Roos disagrees with the writer's statement that in an electromagnetic wave the electric component is ninety degrees, or a quarter wave length, behind the electric component and *considers* (the italics are mine) that they coincide in phase, quoting Stokes and Maxwell in support of his *belief*. The writer wishes to point out, however, that all authorities are not with Mr. Roos." He then quotes Fleming's "Principles of Electric Wave Telegraphy," page 333, where the statement is made that "the magnetic flux and electric strain are periodic or fluctuate harmonically in space and time, *but the magnetic flux is a maximum when the electric force is zero, and vice versa*" (the italics are mine).

In replying to Mr. Pickard's remarks I deem it necessary to discuss our differences of opinion under two distinct points. Firstly, lest there be any misunderstanding as to the status of the general question of electric and magnetic component phases in an electric wave at a distance from the oscillator, I wish to state that it is mathematically impossible to have at constant velocity a plane wave, or a wave with spherical front unless the electric and magnetic components are in phase. From Maxwell, Helmholtz and Heaviside down to any text-book on the subject this fact is demonstrated. Mr. Pickard, in relying on the position attained by Fleming's book, which is more eclectic than original in character, has inadvertently stumbled upon a palpable contradiction of the equations on page 332 of the same work by Professor Fleming himself, so that the sole apparent contradiction of this axiom of wireless engineering theory and practice is found to be the result of an error by Professor Fleming in discussing his adaption of Hertz's equations, which is given correctly on page 332 of this work.

We have there given $P = AElmn \sin (m\tau - nt) \sin \frac{\odot}{\tau}$ for the magnetic component at a distance, and $Z = -E\,lm^3 \sin (m\tau - nt) \sin^2 \frac{\odot}{\tau}$ for the electric component. These are obviously in the same space and time phase, and how they could be interpreted as they are on page 333, which Mr. Pickard so confidently quotes, is difficult to understand.

Secondly, in regard to Mr. Pickard's very interesting experiment [1], which apparently showed a difference of phase in the receiver of ninety degrees in the electric and magnetic components, I wish to call attention to the fact that since all resonance effects in circuits containing distributed inductance and capacity are dependent upon the formation of stationary waves, we must, in accordance with the very nature of the phenomenon of transmitter or receiver resonance, have the two components in quadrature with each other in transmitter or receiver. Mr. Pickard's experiment illustrates very prettily this well-known fact, but does not, of course, and can not, prove anything as to the phase relations of the components where the wave assumes its true radiative character, *i. e.*, beyond about one-quarter wave length away from the receiver or transmitter. Sir Oliver Lodge, in his "Modern Views of Electricity" (1907), shows in a popular manner, in pages 300-303, the gradual acceleration of the phase in one component of the wave outward toward the point of radiation. J. S. Stone, ELECTRICAL REVIEW, October 15, 1904, shows the same thing.

It is to be hoped that with the above references to works of established accuracy and my explanation of the meaning of Mr. Pickard's empirical result that it will not be necessary to do more than advise him to consult any standard work for further and more detailed analysis which may make the fact evident that he has adopted an entirely erroneous view of a free wave in space and of a stationary wave's relation to the exciting free plane or spherical wave. A. C. Roos.

[1] ELECTRICAL REVIEW, February 15, 1908.

[2] *London Electrician*, September 20, 1907.

[3] Ibid, August 30, 1907.

Machinery Manufacturers' Convention.

The joint convention of the American Supply and Machinery Manufacturers' Association, the National Supply and Machinery Dealers' Association, and the Southern Supply and Machinery Dealers' Association will be held at Richmond, Va., May 13, 14 and 15. It has been definitely announced that the Hon. William H. Taft, Secretary of War, will address a joint meeting of the three associations on the afternoon of Wednesday, May 13.

[1] ELECTRICAL REVIEW, February 15, 1908.

Surface-Contact System in London.

The Griffiths-Bedell surface-contact system is to be introduced on a street-railway line in London, England, carrying a larger amount of traffic than has yet been dealt with by a system of this kind. This is a line from Aldgate to Bow, one of the main arteries of traffic through the East End of London, and if it is found to be reliable on this line, it should be able to meet any other urban conditions. The "G. B." system has been tried before in England, an experimental track being laid in 1903 in Illford. This worked so well that in 1905 the system was installed in Lincoln in order to avoid the use of the overhead trolley. The Lincoln installation was put in operation in November, 1905. It consisted of one and three-fourths miles of route, and over this were operated eight large cars. This line had no grades nor curves, and the energy consumption was found to be 1.18 kilowatt-hours per car-mile, which was reduced after some months of operation to about one kilowatt-hour per car-mile, the decreased consumption being attributed to a reduction in leakage. When the line was put into operation, the leakage was about half an ampere at 500 volts for the three miles of track. This has fallen to two-tenths of an ampere, and is still decreasing. The system was decided upon for the London route because of the objection to the overhead trolley and the difficulty of constructing a conduit system due to the presence of the Whitechapel & Bow Subway. Two and one-quarter miles of the contact system are to be installed and three-quarters of a mile of the overhead trolley. It is estimated that for this route the cost per mile of conduit system would be $85,000 and for the surface contact system $52,500. The overhead system would cost $47,500. The agreement with the borough council permits the council to reject the contact system at the end of one year if it does not prove satisfactory. The total cost for the entire equipment, including the current collector on the car, will be about $415,000. The system to be employed differs a little from that used at Lincoln. The line is fairly straight and practically level. At one point a pit is provided where the line forms a junction of several conduit roads, enabling the cars to be fitted with plows for passage over any of these. In the proposed system the working conductor consists of a steel wire cable one and thirteen-sixteenths inches in diameter, carried on insulators of the spool type in an earthenware pipe. This pipe is laid under the centre of the track and the current passes to the cars through studs placed at short intervals on the street surface. The connection between the studs and the cables is effected magnetically at the moment the car magnet comes over them and ceases immediately it leaves them. The feeder cable runs under the side of the streets in the usual way and is tapped at intervals into the working conductor, which is divided into half-mile sections. The tube is egg-shaped, the section measuring five inches horizontally and six inches vertically. It is embedded in concrete, the total depth of the trench being about twenty inches measured from the top of the pavement. The insulators are carried on galvanized steel pins, allowing a certain amount of movement, which assists in the drawing in of the cable. These pins are all connected together by an iron strip which enables the position of any defective insulator to be quickly located. Boxes are placed at intervals from two to four hundred yards along the track, which permit the cable to be drawn in and out. The cable itself is threaded through six-inch lengths of galvanized iron pipe, which furnishes the contact surface, the cable itself not being satisfactory for this purpose. The contact studs are supported on granite plugs recessed to receive them. They are ten inches by two and one-half inches. The vertical part of the stud projects downward into an upright piece of pipe communicating with a forked tube lined with brass. Within the fork is the only movable part in connection with the electrical equipment of the track. This is a piece of galvanized iron suspended freely by means of an insulated steel coil spring heavily coated with copper. At the lower end of the moving piece is a carbon contact block with a copper clip, flexible leads connecting the clip with the main portion of the stud. When the car magnet passes over the stud, the moving piece is magnetically attracted downward toward the working conductor, against the pull of the spring, bringing the carbon block in contact with the pipe over the cable. As soon as the car has passed, the moving part is withdrawn by the spring from the cable and the stud is left dead. The durability of the spring is insured, because the maximum possible extension is well within the elastic limit and the spring is not subjected to jars. Experiments have shown that it should have a life of over twenty years. The contact equipment of the cars consists of a magnet, a current collector and a small storage battery. The magnet is suspended rigidly and the exciting coils and battery are connected so that when the motors are taking current this current assists the batteries when small, and when large recharges the batteries. With this arrangement no special recharging is necessary. The current collector is a series of iron links suspended under the magnet, and they are deflected magnetically so as to come in contact with the stud as they pass over it. Should the system break down so as to leave a stud alive, the usual method of short-circuiting the latter and blowing the fuse is not employed, but a special contact causes a momentary short-circuit through the car, opening the circuit-breaker. At this signal the conductor places over the defective stud a warning mark; then the car proceeds on its way. The following car moves this marker, replacing it after it has passed. This avoids shutting down the system on account of a defective stud.—*Tramway and Railway World* (*London*).

Western Electric Company.

The amount of goods billed by the Western Electric Company for the first three months of 1908 was about fifty per cent less than for the same period last year. In the amount of new orders coming in, the percentage of decrease will not be so heavy. At the close of its fiscal year. November 30 last, the company had a floating debt in bills and accounts payable of $11,449,000. Since the opening of the new fiscal year the company had effected, up to the first of March, a reduction in floating obligations of $2,500,000, with a loss in cash of but $650,000. This rapid reduction in outstanding obligations will probably make it unnecessary for the company to issue the $15,000,000 bonds authorized some time ago.

The Ohio Electric Light Association.

The fourteenth annual convention of the Ohio Electric Light Association will be held at the Hotel Victory, Put-in-Bay Island, Ohio, on Tuesday, Wednesday and Thursday, August 25, 26 and 27.

This promises to be the largest convention that the association has ever held. Particular attention has been paid to the entertainment for the ladies, and it is expected that they will be represented very largely at the coming convention. The papers presented will be entirely by central-station men, and the question box will be made a particular feature of the sessions.

NOTES ON PATENT PROCEDURE.

BY F. W. BLAIR.

Inventors and engineers employed in developing new apparatus, and devoting practically their entire time to the technical details directly under consideration, seldom acquire any considerable knowledge of patent procedure, and are usually compelled to leave this important branch of the work entirely in the hands of the patent attorney.

A certain amount of knowledge upon this subject, however, is of considerable assistance to the inventor in preparing his invention for the attorney, and, although it is of the utmost importance that he secure the best counsel obtainable, it is nevertheless greatly to his advantage to acquire as thorough a knowledge of patent procedure as possible, for he is then enabled to detect mistakes, or inferior work, on the part of his attorney, and is otherwise prepared to render him valuable assistance in drawing the necessary papers for the Patent Office.

In nearly all cases the inventor of a device, upon which a patent is to be solicited, is required to prepare a description, and sketches, where possible, of his invention, stating, in more or less detail, its construction and mode of operation, and enumerating the advantages which it possesses over other devices of similar construction already upon the market. This description oftentimes forms the sole basis upon which the patent papers are prepared by the attorney.

Especially is this true where the inventor and his attorney are unable to come in direct contact with each other and the work has to be carried on entirely by correspondence, as is often the case.

A knowledge of patent law is also oftentimes invaluable to the independent inventor as a protection against the pernicious and fraudulent practices sometimes employed by the cheaper class of patent attorneys.

In the selection of an attorney it may be generally stated as unwise to employ parties who guarantee to obtain patents for their clients, or operate upon the no-patent-no-fee plan, for such parties make little or no effort to conserve the interests of their clients, and are concerned solely in getting the application through with the least expenditure of time and labor possible, in order to obtain their fee, and will so word the claims that the patent is practically sure of issue upon the first action by the Patent Office. Such a patent is usually absolutely worthless except as a pretty souvenir.

The first step to be taken, after an idea has been reduced to sufficiently concrete form to warrant a patent application, is to ascertain the state of the prior art, that is, to find out what has already been accomplished along the same line. There are several ways in which this information may be more or less completely acquired.

The inventor may himself make a search through the files of the official gazette, if he has access to a public library, and will in this manner acquire much valuable information.

This method is a long and tedious one, however, and will not, in all probability, be very complete.

Examinations may be obtained through the records of the Patent Office by the attorney for a small fee, usually from five to ten dollars, but these examinations are generally more or less perfunctory in character, since the attorney incurs no liability, and for the small sum involved does not pretend to make a complete list of all the material bearing upon the subject.

A complete set of the specifications of the patents coming under the class, or the subclass, to which the prospective invention belongs may be purchased of the Patent Office at the rate of two cents or three cents each respectively.

The Patent Office is subdivided into thirty-nine examining divisions, each division being assigned certain classes of inventions; there being in all 235 classes (corrected to June 30, 1907). These 235 classes are again subdivided into some 20,000 subclasses.

Classification bulletins[1] are issued by the Classification Division of the Patent Office from time to time, giving revisions in the classification to date, a short perusal of which will usually suffice to determine the class and subclass to which an invention belongs.

A careful study of the specifications contained in the subclass to which the invention belongs will be of great value to the inventor, not only in defining the limits of his invention and acquainting him with the state of the prior art, but as a source of new ideas, which oftentimes will enable him to further improve and perfect his invention.

The claims also demand very careful study in order that infringement may be avoided in drawing up the new claims.

In the light of the knowledge thus secured it becomes a comparatively simple matter to determine whether the device under consideration contains sufficient novelty, and has sufficient intrinsic value, to warrant a patent application.

Questions of invention are questions of fact, and the presence or absence of novelty, in any particular case, can only be finally established through the medium of the courts.

A considerable fund of general knowledge must be possessed by an inventor before he can hope to make an invention of any importance.

After the inventor has satisfied himself as to the advisability of applying for a patent he may proceed to draft the necessary papers.

The complete application will, in most cases, consist of five parts—a petition, specification oath, drawing and filing Government fee of $15.[1]

In the case of process patents, and patents upon compositions of matter, the drawing is obviously dispensed with, but in the case of patents upon compositions of matter, samples of the compound are always required.

Models are no longer required by the Patent Office as a necessary part of a patent application.

Applications will not be dated and filed until all the parts, as enumerated above, have been received by the Patent Office.

The forms for the petition and oath admit of little variation and are substantially the same in all patent applications.

The specification is the longest and most important document in the application, and much thought and skill are required in framing it.

The Patent Office recommends the following order of arrangement of its parts:

1. Preamble stating the name and residence of the applicant and the title of the invention.
2. General statement of the object and nature of the invention.
3. Brief description of the several views of the drawings (if the invention admits of such illustration).
4. Detailed description.
5. Claim or claims.
6. Signature of the inventor.
7. Signature of two witnesses.

Of these, parts Nos. 1, 6 and 7 are matters of form, common to all patent specifications, and require no further ex-

[1] See Classification Bulletins. No. 16 to No. 19; October 1, 1904 to June 30, 1907, inclusive.

[1] Rules of Practice in the United States Patent Office, a copy of which may be obtained upon written request to the "Commissioner of Patents," Washington, D. C.

planation, while parts Nos. 2, 3, 4 and 5 are variable in character and admit of somewhat further subdivision.

2. The general statement should contain, first, a definition of the invention in the most general terms, thus indicating the subclass to which it belongs.

Second, a short statement of the prior art, followed by an enumeration of the advantages secured by the invention, and presumed to constitute the advance in the art.

Third, a detailed definition of the invention including all its salient features.

The above subdivisions of the general statement are susceptible to considerable variation, but are usually followed in most well-composed specifications.

3. The brief description of the drawings consists of a paragraph enumerating the different views and stating their relation to each other and, if sectional views are shown, giving the planes upon which they are taken.

4. Where drawings are admissible the detailed description constitutes a complete explanation of these drawings, by the aid of reference numerals, and closes with a statement of the best mode of operating the invention.

5. The claims constitute the inventor's protection from infringement and are a most necessary part of the specification; the preceding matter being only for the purpose of rendering the claims more intelligible.

The breadth of the claims is, therefore, the point to which the inventor should give his closest attention.

It is the practice of some solicitors to write the claims in vague terms, in the belief that this vagueness of definition will prevent contemporary inventors from developing similar apparatus, through their inability to define the exact limits of the invention. This is a dangerous practice, however, since vagueness in a claim detracts from its value and renders its validity questionable.

In the case of a primary invention, that is, an invention which performs a function never performed by any earlier invention, it is customary to write a generic claim first, and follow with more specific claims. Later, if the generic claim is proven to be too broad to stand, the patent may still be of value through the validity of some or all of the specific claims.

The difference in meaning between generic and specific claims may be best illustrated by a simple example.

Take the case of the ordinary knife-switch, of the quick-break type, provided with a secondary blade, attached to the primary blade by means of a spring.

Assuming that no type of quick-break knife-switch has heretofore been invented including the secondary blade and spring connection, how may the claims best be worded to cover the combination? It is evident that the complete mechanism consists of the following elements:

Insulating base, two clips for receiving the combination of blades, one being the hinge clip, primary blade, secondary blade, and connecting spring between primary and secondary blades. Of these, the parts constituting the simple knife-switch are assumed to be old, and therefore can not be included in the claims of the new combination.

A generic claim may be worded something as follows:

An electric switch, comprising fixed clips, primary and secondary connecting blades, pivotally mounted within one of said clips and adapted to engage the same, and means for automatically withdrawing said secondary blade from its clip, upon separating the primary blade therefrom by a fixed distance.

This claim may be stated in various ways, the prime object being to get a definition so worded that any attempt to construct a knife-switch employing the secondary quick-break principle will be an infringement upon the claim.

In order to do this in the most effective manner the claim should be worded in general terms, and all qualifying phrases omitted where possible.

The above example may be extended to include specific claims by adding distinctive features in the construction of the switch. For instance, it is found desirable to add a stop of some sort to the primary blade, in order to start the secondary blade out of its clip, after the primary blade has been opened a certain predetermined distance; the tension of the spring alone not being sufficient to accomplish the purpose. This improvement may be incorporated in a claim, which might be stated in the following terms:

An electric switch, comprising fixed clips, primary and secondary connecting blades, pivotally mounted within one of said clips and adapted to engage the same, and means for automatically withdrawing said secondary blade from its clip, upon separating the primary blade therefrom by a fixed distance, determined by means of a stop, mounted upon the primary blade and engaging the secondary blade at a fixed angle.

This claim is narrower than the first, since it introduces the added element of the stop, and might be allowed where the first claim would be rejected.

This would be the case if a patent was already in force covering the principle of the quick-break attachment, but not embodying the stop. A patent, if granted upon the stop, would be of little value, however, since it would be an infringement upon the broader patent covering the quick-break attachment, and could be used only by the owners of this patent, or through their consent.

The courts have decreed that the addition of new elements to an old combination does not nullify infringement of the old combination, though the additions may be patented as an improvement upon the old combination.

Returning, for the moment, to the question of the search to determine the prior art, it may be stated as better practice to file an application containing broad claims, some of which may be rejected by the Patent Office, rather than go to any considerable expense in obtaining the search.

The cost of filing an application will be little greater than the fee charged for the search, and, with the claims properly drawn, the official action of the Patent Office will bring out the state of the prior art with a much greater degree of certainty than can be obtained through any search.

In the case of a primary patent the inventor is entitled not only to the particular type indicated in his specification, but to every equivalent thereto, and the courts have defined an equivalent to be that which performs the same function in substantially the same manner.

The omission of an element in a combination covered by a claim in a patent averts any charge of infringement based on that claim.

If an inventor develops a process and also machinery or apparatus for carrying out the process, two patents should be solicited: one upon the process and the other upon the apparatus for employing the process.

In some cases it is a difficult matter to distinguish between the process and the means employed for carrying it out. Where the applicant has been allowed a claim for means for effecting a certain purpose and he claims the process of effecting it, but that alleged process can not be conceived as independent of the means and can not be described without reference to the means, it has been held that the

alleged process is the function of the means and is not patentable.

The claims in an application for a patent upon a composition of matter should not contain a statement of the proportions of the ingredients employed, if a patent upon the compound is to be obtained, since by slightly changing the proportions, as given in the specification, infringement of the patent may be avoided.

From two to six months may elapse after filing an application before action is taken upon it by the Patent Office, some divisions being more crowded with work than others.

The statutes require that the Patent Office examiners shall fully and precisely state the reasons for the rejection of any portion of the specification or claims of an application, and shall give such information and references as may be useful in aiding the applicant to judge of the propriety of prosecuting his application or of altering his specification. Owing to the immense volume of business constantly before the Office for action, this statute is not strictly complied with, and the reasons for rejections are not very fully stated.

The examiner usually cites several patents, the claims of which he believes to conflict with those under examination, and it is left with the attorney, or the inventor himself, to ascertain the particular claims which are infringed, to study out in what the infringement consists, and how it may be avoided. If he is unable to see in what manner his application conflicts with the references, he has the privilege of a re-examination, and of appeal to the examiners-in-chief, and finally to the commissioner.

The inventor should allow due time and consideration to the amendment of his claims, and should not hurry his patent to issue, only to find, after it is too late, that he has seriously detracted from its value by leaving unprotected points that, in his haste, were overlooked.

Applications are oftentimes kept in the Patent Office for several years before they are allowed to issue.

It is the practice of the examiners to allow just as little as possible, and the inventor, or his attorney, is required to demand the grant of all that rightfully belongs to him.

After the patent application has been put in proper form to be allowed, it passes to the Interference Division, and if it is found that another application is pending upon a similar invention, the applications are placed in interference, and proceedings are instituted to ascertain which of the two applicants was the first to conceive the invention.

The applicant whose application bears the earlier filing date is presumed to be the lawful inventor, and it lies with the other claimant to prove the priority of his invention.

Six months is given, after notice of allowance, before the final fee of $20 is required to be paid.

This period is a proper time in which to dispose of the invention, or to file patent applications in any foreign countries in which the inventor may wish to secure protection.

The United States patent protects the inventor against foreign manufacture for importation, use or sale in this country, but it offers no protection whatever against manufacture, use and sale in any foreign country.

Section 4887 of the Patent Act of 1903, regarding foreign applications, states that "No person otherwise entitled thereto shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid by reason of its having been first patented or caused to be patented by the inventor or his legal representatives or assigns in a foreign country, unless the application for said foreign patent was filed more than twelve months prior to the filing of the application in this country, in which case no patent shall be granted in this country."

Since the countries in the International Patent Union[1] observe this rule, an application in any of these countries may be filed within one year after filing the application in this country.

The London County Council's Tramways.

The report of the experts appointed last summer to act as independent auditors to make a report on the movements of the London (England) County Council's tramways, steamboats and working-class dwellings has been presented to the council by William Peat, president of the Institute of Chartered Accountants, and F. W. Pixley, past-president of the institute.

Three main points are shown by the auditors: (1) A sum of over $5,000,000 ought to be written off the present assets in respect to horse tramways that have been displaced by electric traction; (2) taking two cents per mile (the council's own estimate) as the proper minimum basis for a renewals reserve fund, this fund is $713,180 short of its proper total; (3) "The council has not dealt fairly," to quote the auditors' own words, "with the cost of street improvements and widenings." A further substantial, but as yet unascertained, sum should be charged to the tramways account in respect of these.

In the six years from 1897-1898 to 1903-1904, $1,465,000 was paid in relief of the rates out of the earnings of the horse-traction system, and the auditors consider that these amounts should have been reserved toward writing off the loss.

If two cents per car-mile had been reserved, the amount which ought to have been set aside from April 1, 1903, to March 31, 1907, would have been $913,180. The actual amount set aside was $525,000; hence there has been a deficit in the charge against revenue to that date of $388,180. In the estimates for 1907-1908 it is shown that two cents per car-mile for renewals will amount to $500,000. The provision proposed is $175,000. If this estimated provision for 1907-1908 is carried into effect there would be, on March 31, 1908, $713,180 short charged to revenue since April 1, 1903, in respect of renewals. This leaves out any provision for renewals of the machinery, plants and buildings of the generating stations. In the last report of the tramways system for the year ended March 31, 1907, the surplus revenue is shown as $48,365; but if two cents per car-mile had been charged for renewals, the tramways undertaking would have shown a deficit of $290,535.

The auditors also take exception to the method of charging for improvements and widenings in streets through which the tramways are constructed. The proper charge has not been placed against the tramways accounts. In one case an expenditure of $345,000 was incurred, and the council resolved to postpone the charge to tramways account "until such time as the profits of the proposed tramway shall be sufficient to meet the annual charge in respect of the capital outlay."

Receiver Appointed for the Union Railway.

On the application of the Lorain Steel Company, Judge Lacombe, in the United States Circuit Court, on March 31 appointed Frederick Whitridge temporary receiver of the Union Railway Company, which operates the "Huckleberry" lines in the borough of the Bronx, New York city, and in Westchester County, N. Y. The action was brought to recover $23,323.74 for material furnished and labor performed, which the railway company was unable to pay, besides being unable to satisfy a judgment of $12,600 on March 20.

[1] For a concise statement of the patent laws of the principal foreign countries, see the Official Gazette, vol. 83, p. 916.

FUSE PHENOMENA.[1]

BY ALFRED SCHWARTZ AND W. H. N. JAMES.

(Concluded.)

THE TIME ELEMENT.

Experiments were made to determine the relative time element for fuses of a given metal having the same cross-sectional area in cutouts of open and enclosed types.

Expressing the overload as a percentage of the normal fusing current, it was found that enclosing the fuse increases the time element. This is particularly noticeable for small overloads, which allow of sufficient time for the conveyance of heat to the filling before the fuse is disrupted. For large overloads the difference in time element is not so marked, since the time is too short for much heat to be conveyed to the filling. Since the normal fusing current for an enclosed fuse is considerably greater than that of the same fuse when free in air from terminal to terminal, and since we are expressing the overload as a percentage of the normal fusing current, it is on this basis conceivable that an enclosed fuse would operate more quickly than an open one of the same cross-sectional area owing to the larger current taken by the enclosed fuse. This is found to be the case and it was also found that for a given size of copper wire there is a good deal of difference in the normal fusing current for the various kinds of filling. The filling not only influenced the time taken to blow the fuse with a given current, but also the normal fusing current, and consequently the percentage overload, which is based upon it; and it is evident that these two effects tend to neutralize each other.

A copper wire in an enclosed cutout with Calais sand filling was found to have a normal fusing current of thirty amperes. A second copper wire was then taken and drawn down so as to have as nearly as possible this normal fusing current in air. The time elements for these two wires were then found for various overloads, and the results are shown graphically in Fig. 5, where the crossing of the curves owing to the smaller amount of metal in the enclosed fuse is clearly shown.

TEMPERATURE RISE FOR JACKET OF ENCLOSED FUSES.

The chief factor which determines the temperature rise of an enclosed fuse as measured by the external temperature attained by the jacket is the melting point of the metal employed, metals with high melting points on continuous overloads giving a higher external temperature on a jacket of given diameter than those of greater fusibility.

In Fig. 6 curves are given of the temperatures attained by the outside surfaces of red fibre tubes with Calais sand filling with tin, zinc and copper as the fuse metals when run with various percentages of their fusing currents.

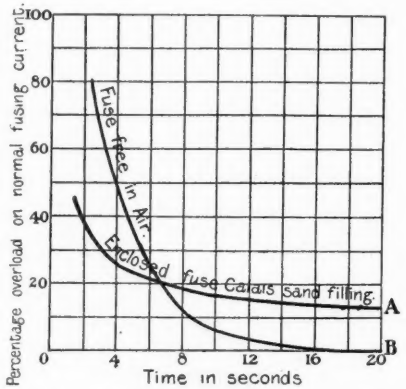


FIG. 5.—RELATIVE TIME ELEMENTS FOR COPPER FUSES.

A consideration of this figure shows that copper gives the highest temperature rise, but that when running at fifty per cent of its normal fusing current (*i. e.*, when rated to blow with 100 per cent overload) the temperature attained even at full load is not excessive, and that when running at the rating given in the Institution Wiring Rules, namely, 200 per cent overload for fusion—the external temperature of the jacket does not differ very materially from that obtaining with zinc and tin.

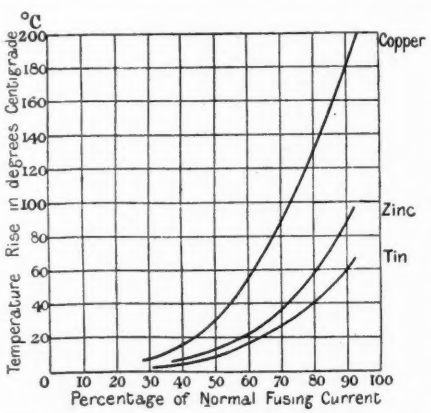


FIG. 6.—EXTERNAL TEMPERATURE RISE FOR FUSES OF DIFFERENT METALS ENCLOSED IN RED FIBRE TUBES, ½-INCH INTERNAL AND ¾-INCH EXTERNAL DIAMETER, AND 2.4 INCHES LONG.

Normal fusing currents when enclosed:
Tin, 28 amperes.
Zinc, 26 amperes.
Copper, 30 amperes.
The filling in each case was Calais sand.

The temperatures in each case were determined by means of a platinum wire spiral wound closely over the jacket. With regard to the temperature of the inside of the jacket a number of determinations were made which showed that the inside temperatures were not greatly in excess of those obtaining outside except in the case of copper.

The temperature rise of the jacket is a function of the diameter of the cartridge employed; the smaller the latter is the higher will be the external temperature of the jacket. From the point of view of low-jacket temperatures, fillings with a low heat conductivity are desirable.

In order to determine the effect of the jacket material on the external temperature attained, similar tubes of red fibre and of brass were employed as jackets. In order that the temperature of the metal tube could be measured by means of a platinum spiral both jackets were covered with a thin layer of asbestos paper. The difference in temperature rise with a given load in the two cases was found to be very slight, the external temperature of the metal tube being slightly higher than that of the fibre tube.

NOTE ON THE RATING OF FUSES.

A good deal of confusion exists as to the rating of fuses owing to the variety of conditions on which this rating may be based; the following suggestions are therefore put forward with a view of possibly clearing away some misconceptions.

Since the various circuits met with in practice are capable of withstanding without injury definite amounts of overload, this fact would seem to afford a sound basis for fixing the limit for the normal fusing current of the fuse employed to protect the circuit.

The fuse may with advantage be designated by the normal full-load current of the circuit on which it is to be employed. Thus, a "fifty-ampere fuse" would mean a fuse for the protection of a circuit the normal full-load current of which is fifty amperes.

The fuse may be designed to blow with any current greater than this that may be desired.

The fuse selected should be such that when carrying continuously a current slightly less than its normal fusing current no injury to the circuit due to overheating should result.

Assuming in a given case that we decide to work with a factor of safety of 2 on the Institution of Electrical Engineers' limit for the maximum temperature, and to take their figure for the permissible normal full-load current of the circuit, we can then express the normal fusing current of the fuse required as a multiple

[1] Abstract from a paper read before the Institute of Electrical Engineers of Great Britain.

of the normal full-load current of the circuit.

The figure obtained by dividing the maximum permissible overload by the full-load current of the circuit represents the "sensitiveness," or, more correctly speaking, the insensitiveness of the fuse.

It should not be a difficult matter to determine the suitable sensitiveness for fuses required for the protection of arc-lamp, heating or motor circuits.

The normal fusing current for a fuse should be determined by direct experiments. A curve should be plotted for fusing currents on a time base, taking, in the first instance, currents slightly in excess of the normal fusing current and then reducing the current and noting when the current curve becomes parallel to the axis of time.

This procedure is a little laborious but is absolutely necessary in view of the length of time which large enclosed fuses take to attain a steady temperature.

The normal fusing current for a given line of fuses should be obtained by the manufacturers or by an independent testing authority and the fuses marked with their rating before being placed on the market.

NOTE ON THE TIME ELEMENT OF FUSES.

We have seen that the rating of a fuse may be determined from a consideration of the permissible temperature rise in the circuit to be protected; the time element of a fuse is, however, dependent upon the heat capacity of the fuse and its immediate surroundings. The time element of a fuse may be defined as the time lapse necessary for the heating of the fuse from the cold state to the fusing point with a given overload.

The heat capacity of a fuse will be proportional to the mass heated, the average specific heat of the mass, and the temperature rise from the cold state to the melting point.

With enclosed fuses this heat capacity will vary with the character of the overload, since with large overloads there is insufficient time for the conduction of heat from the fuse to the filling, and the temperature rise of the latter is consequently small.

Apart from the above consideration the time required for reaching the fusing point is, for a given fuse, inversely proportional to the square of the current.

The heat capacity of a fuse may be varied by changes in: (*a*) The fuse metal. (*b*) The shape of the fuse. (*c*) The environment of the fuse.

These variations may be made use of for altering the time element of a fuse for a fixed rating to a considerable extent. The greatest difference in time element will be between an open fuse of copper and an enclosed fuse of a sluggish metal such as tin or zinc.

It is desirable that a definite basis for reference should be established for the time element, and we would suggest that the time element of a fuse should be defined as follows:

The time element of a fuse is that time which is required to heat up the fuse from the cold state until it blows with an overload of fifty per cent reckoned on the normal fusing current of the fuse.

For large-size enclosed fuses the time element as defined above would be of the order of four or five minutes. For metals with low melting points the time element will be decreased if the external temperature is high.

NOTE ON SHORT-CIRCUIT CURRENTS.

It is evident that the position of a fuse on a system with reference to the generators will largely determine the character of the current rush on short-circuit; it would, therefore, seem advisable that fuses should be tested with the short-circuit currents which would be likely to be met with in the class of circuit which they are intended to protect. It should not be expected, for instance, that a fuse on a distribution board in a house installation should be tested on a dead short-circuit across station bus-bars.

We have restricted this paper to a consideration of fuses up to fifty amperes for house service, and in this class of installation the maximum drop in volts with the full-load current is usually limited to two per cent. With the fuse rated to blow with twice the full-load current this maximum drop would be doubled, so that as an average value with the normal fusing current of the fuse flowing in the circuit a drop of three per cent may be taken; this value is also supported by experimental evidence. As already pointed out, this arrangement neglecting the resistance of the fuse allows of a short-circuit current of thirty-three times normal fusing current of the fuse.

Whether a fuse on short-circuit blows before the current has time to reach the value limited by the resistance of the circuit depends upon the nature of the fuse, the amount of the short-circuit current relative to the normal fusing current and upon the inductance of the circuit.

The German regulations as to short-circuit tests are as follows:

"The output capacity of the source of current and the resistance of the leads are to be so arranged that at the time the fuse blows the total fall of pressure in them shall not exceed one per cent. These conditions will be regarded as being fulfilled if in the place of the fuse an adjustable resistance is placed arranged to carry a current of twenty times the normal carrying capacity of the fuse (this current must not, however, be less than 400 amperes), and at the same time the pressure across the terminals of this resistance must not be less than the normal pressure of the circuit for which the fuse is intended, the drop in the rest of the circuit being not more than ten per cent of this. When matters have been arranged to comply with the foregoing conditions the switch is to be opened, the resistance removed, and the fuse replaced. On closing the switch the fuse must melt without maintaining an arc and without explosive violence."

We have found that when the short-circuit current was limited to thirty or forty times the normal fusing current for a twenty-ampere fuse, the magnitude of the short-circuit current was independent of the capacity of the generators employed within the limits of one fifty-kilowatt machine and four 100-kilowatt generators with a 450-ampere-hour battery in parallel. It would seem, therefore, that if the current rush on short-circuit is limited as above for testing purposes, the capacity of the generator need only be such that it will not be seriously overloaded by the short-circuit current in question. Since the duration of the short-circuit current is so small, being of the order of a few hundredths of a second, the voltage of the machine is maintained. In the authors' experiments two or three 100-kilowatt machines were employed in parallel with the battery mentioned above.

NOTE ON THE END CAPS OF ENCLOSED CUTOUTS.

In enclosed cutouts in which the fuse wire or strip is carried through a hole or slot in the end cap or ferrule and then secured by solder or in a terminal of some sort, it is necessary to protect these holes from damage from the arc, particularly if they are used as gauging devices to limit the wire or strip employed to a predetermined size.

If the distance between the end caps is such that an arc can be set up between them, the hole or slot will either be considerably enlarged or damaged by fusion, or the wire or strip ends will become fused to the caps.

This can be prevented by a device due to one of us in which the fuse wire or strip before entering the hole or slot in the end cap or fuse contact makes contact with a washer or other easily renewable metal piece which is in electrical contact with the end caps or fuse contacts, and is, therefore, at the same electrical potential as they are. The damage will then be confined to the removable metal piece.

It would appear advisable to do without free holes or openings in the end caps as far as this is possible, as they not only allow of the emission of flame on short-circuit, but seem to favor the persistence of the arc.

Theodore N. Vail to the Stockholders of the American Telephone and Telegraph Company.

One of the most interesting and illuminating analyses of the business of telephone service generally is found in the report of Theodore N. Vail, president of the American Telephone and Telegraph Company, to the stockholders, covering the results of the year ended December 31, 1907, and recently issued. An abstract of this report covering the financial operations appeared in a recent issue of this paper. Mr. Vail's discussion of the telephone business affords some interesting information concerning the organization of the company. Following is an abstract of this portion of the report:

Much of the agitation against legitimate telephone business is founded on false and exaggerated statements of the profits originally made by the early Bell companies.

These statements have been used by the promoters of both good and bad enterprises.

As a matter of fact, the shareholders of the American Bell Telephone Company and its predecessors paid into the treasuries of those companies more actual cash than was represented by the capitalization at par value.

The only shares of the American Bell Telephone Company not issued for cash at par or at a premium were the shares amounting to $5,100,000 issued in exchange for the shares and property of the National Bell Telephone Company. The premiums received by the company on further issues of stock amounted to more than this sum.

The substitution of the American Telephone and Telegraph Company for the American Bell Telephone Company was, in effect, the purchase of the property of the American Bell Telephone Company for cash at somewhat less than the average market price prevailing prior to the purchase. None of the American Telephone and Telegraph shares now stand on any other basis than cash at par value.

In view of the enterprise shown and the risk incurred by the original investors, who received no interest or dividends for years, the return was certainly not large to those who created an enterprise which has probably done more to bring about a new and advantageous condition in the affairs of mankind than any other industry in the history of the world.

For the purpose of determining the relation between the physical plant and the capitalization, a valuation of the exchange, toll and long-distance line plant included in the Bell system was made at the close of the year. The valuation was based on the replacement cost of the existing plant, and does not include any "unearned increment" or allowance for franchises, but assumes a clear field and free franchise. When to this valuation is added the value of rights of way now unobtainable, patents, franchises and other valuable considerations, it will be conceded that the Bell system is unique. This showing is interesting and should serve to correct some popular but erroneous impressions.

January 1, 1908, all obligations of the American Telephone and Telegraph Company and its associated operating companies in the United States, including capital stock at par held by the public, were	$554,939,000
Cash on hand, quick receivables, working assets and sundry investments were	101,074,000
Balance, capital representing plants	453,865,000
The plants are carried on the books of the various companies at	492,496,000
Appraised value by engineers (copper at fifteen cents)	488,296,000
Outstanding obligations against plant	453,865,000
Appraised value in excess of outstanding obligations	34,431,000
Book value, exchange construction only, per exchange station	114
Book value, all plant (toll line and exchange) of Bell operating companies in United States (not including long-distance), per exchange station	149
Book value, all plants in the United States, including long-distance, per exchange station	162

The unusual production and prices, during the past few years, of those commodities which this country sells to the whole world, with accompanying very general distribution of wealth, resulted in an almost phenomenal financial and industrial activity, stimulating new enterprises and promotions of all kinds, among them independent telephone companies.

It would seem, as a whole, that the gain of the public through competition based on low rates has not compensated for the loss of capital invested in these enterprises.

During this period of strife and rush for development and extension many subscribers were connected to exchange systems with little or no benefit to themselves or advantage to others, and much was done that under ordinary conditions would not have been done.

The result of these conditions has been to create in the minds of the public, and of public bodies, misleading and mistaken ideas of the telephone business. It has encouraged attempts at regulation of rates and business on lines that if obligatory or persisted in would be ruinous. In controversies as to rates the policy of our associated companies has been to make a complete and absolute showing of the condition, cost and value of plant, cost and value of service, cost and necessity of proper maintenance, and the broad position is taken that neither our company nor the associated companies have anything to conceal or anything to apologize for.

Fair rates would insure high-class plant and equipment maintained at a high state of efficiency, and would provide fair wages to employés, the highest paid for similar class of employment. Both of these are necessary to good service.

Fair rates should give fair return on the investment and promise fair return on new money needed. This is necessary to maintain the interest of the existing shareholders in the proper administration of the business, as well as to provide for the continually increasing public demand.

Any revenue produced over and above such requirements and the proper reserve to provide for contingencies could be used for the benefit of the public, allowing the company to retain a part sufficient to stimulate the most efficient and economical management. It would be difficult, if not impossible, to get effective and economical management, such as would produce the best results for both public and the shareholders, without recognizing this principle.

The value of any exchange system is measured by the number of the members of any community that are connected with it. If there are two systems, neither of them serving all, important users must be connected with both systems. Connection with only one is of but partial value and can not be satisfactory. Two exchange systems in the same community, each serving the same members, can not be conceived of as a permanency, nor can the service in either be furnished at any material reduction because of the competition, if returns on investment and proper maintenance are taken into account. Duplication of plant is a waste to the investor. Duplication of charges is a waste to the user.

It is contended that if there is to be no competition there should be public control.

It is not believed that there is any serious objection to such control, provided it is independent, intelligent, considerate, thorough and just, recognizing, as does the Interstate Commerce Commission in its report recently issued, that capital is entitled to its fair return, and good management or enterprise to its reward.

An exchange system is made up of circuits (each consisting of two wires) radiating from a central office, or from central offices connected by trunk lines, so arranged that each circuit can be connected directly or through trunk lines with the others. There are in these circuits of the Bell system about 7,000,000 miles of wire—over two miles of wire to each subscriber—one-half in underground conduits. The system of radiating circuits is the most expensive part of the exchange system to build, it is least durable, therefore most expensive to maintain, calls for the largest part of the total investment, and consequently must bear the largest part of the cost of capital.

The real value of a telephone exchange system depends entirely on the distribution and number of other members of the same or other communities connected with the same or connecting systems, with whom any subscriber can have prompt and satisfactory communication.

Any member of a community connected with an exchange system can be reached as well, but not as conveniently, from a central or public office as from a subscriber's station.

To reach any member of a community not connected with any exchange system, whether from public station or subscriber's station, is too inconvenient and impracticable to be considered for ordinary use.

Therefore, the particular circuit connecting any subscriber with the exchange is what might be termed a convenience to that particular subscriber, but a necessity to all other subscribers.

It is not merely the maintenance of the

individual circuit connecting with the exchange that is paid for by any subscriber; it is in a greater measure the use from time to time of the circuits, trunks and facilities which make communication possible with all other subscribers.

As the value of the exchange to the subscriber depends upon the number of subscribers within reach, rates must be so established that the maximum number of subscribers can be obtained, so that the greatest number of those with whom communication may be wanted will be connected with the exchange. The cost of any circuit, therefore, must be largely distributed between those who may desire to communicate with the particular subscriber connected by that circuit.

The cost or value can not be exactly distributed—an approximation is reached by measured service charges, or by classification of service between business houses and residences with a sub-classification of plant between "direct" and "party" line.

Business rates are higher, for the reason that presumably the business subscriber connects with the greatest number of other subscribers, and consequently makes use of the greatest number of circuits and operating facilities in an exchange.

Residence rates are lower because the residence subscriber connects with a limited number of other subscribers, and because he makes more limited demands on the central office.

It being established that the measuure of value is not in the particular class of line connecting any subscriber to an exchange, but in the use of the exchange system as a whole, and that the value of any exchange depends on the area covered and the maximum number of desired individuals that can be reached, rates must be so adjusted that no rate shall bear unjustly on particular individuals or classes; that, at some rate, connection with the exchange is within reach of anyone who can add to the value, to others, of the exchange, and, and that, as a whole, the revenue will be sufficient to maintain the plant, pay fair wages, make enough return on capital and enterprise to insure good economical management and sufficient capital to meet the increasing demands of the public.

Toll-line and long-distance communications require, as in exchange connections, the exclusive use of a circuit, two wires, between two points for an interval of time, varying with the conditions; over the whole system the average "time interval" consumed in the completion of each communication is about seven and one-half minutes.

Cost is determined by the capital and maintenance charges of the plant and operating costs, divided by the average number of communications.

Any "time interval" passed without being utilized is lost beyond recovery. A good average can not be made by crowding two or more communications into the "time interval" of one, nor by putting on higher pressure to get more "time intervals" over the same circuit.

There are only a certain number of five-minute "time intervals" in each hour, or five-minute "spaces" on each clock. If you want more "time intervals" or more "spaces," you must take more hours or more clocks. In toll-line business anything above the normal capacity of each circuit must be provided for by additional circuits.

Toll-line or long-distance business requires the presence of the communicating parties; for that reason it is confined to the business or working hours of the day; and further, the greater part of this business is not only limited to those few hours when parties are most likely to be located at some particular place, but to that part of those few hours immediately after the general business of the day has developed. For this reason the greater part of the toll-line or long-distance business is crowded into an exceedingly small part of the business day. The periods of great demand are short. The facilities provided are idle a great part of even the business hours.

Utter disregard for repairs and reconstruction, usually comprised under the head of "maintenance," has been the cause of more misunderstanding on the part of the public and public bodies having to do with rates, of more self—or selfish—deceit on the part of promoters of telephone enterprises, and of more mistakes on the part of the investing public than any one factor in the telephone business.

With a new plant, "current repair" is at a minimum, and can be for a time disregarded; with a growing plant, it is too easy to lose it in construction; but sooner or later, if not provided out of current revenue, where it belongs, it will be found either in increased construction—that is, capital charges—or in a depreciated plant.

In any consideration of this question the leaning should be toward liberal rather than inadequate maintenance. In any properly administered company any excess would be found in betterments or construction, and consequently in reduced capital investment, while inadequate maintenance would soon show in quality of service and in reconstruction requirements. In other words, surplus maintenance would be offset by decrease of capital charges, while inadequate maintenance requiring new construction in time would increase capital charges.

Producer-Gas Power Plant Fuel Tests.

The accompanying table, published by permission of the Director of the United States Geological Survey, shows the results obtained on a wide range of fuels tested by the technologic branch of the United States Geological Survey, under the direction of Joseph A. Holmes, expert in charge, and Robert Heywood Fernald, engineer in charge. These tests were made at St. Louis, Mo., at the fuel-testing plant which was located on the grounds of the Louisiana Purchase Exposition.

At the time this plant was erected there were but few gas-producer plants in the country burning any class of bituminous coals, and many prominent engineers were in doubt as to the possibility of operating a gas engine on gas produced from coals such as are mined in the central and western states.

This branch has done a valuable service to the country in demonstrating the possibility of burning nearly all classes of low-grade fuels with good economy. As will be noted in the table, the poorer coals required a correspondingly greater quantity of the fuel to produce a horse-power.

The equipment used was a 250-horse-power pressure producer with a centrifugal tar-extractor and gas-holder. A 235-horse-power, three-cylinder vertical gas engine belted to a generator produced power which was measured by electric instruments connected with the switchboard.

TABLE OF DATA AND RESULTS ON REPRESENTATIVE FUELS BURNED IN A PRODUCER-GAS PLANT AT THE FUEL-TESTING PLANT OF THE TECHNOLOGIC BRANCH, UNITED STATES GEOLOGICAL SURVEY.

Fuel.	Proximate Analysis. Per Cent.				British Thermal Units per Pound of Fuel.		Cubic Feet Standard Gas Produced per Pound of Equivalent* Fuel Consumed by Producer Plant.		British Thermal Units per Cubic Feet of Standard Gas.	Pounds of Equivalent* Fuel per Brake Horse-Power-Hour.	
	Moisture.	Volatile Matter.	Fixed Carbon.	Ash.	As Fired.	Dry.	As Fired.	Dry.		As Fired.	Dry.
Florida peat	21.00	51.72	22.11	5.17	8,127	10,289	28.5	36.1	175.2	2.57	2.03
Average of four lignites	35.05	28.96	27.72	8.27	7,164	11,038	26.3	40.3	169.9	2.43	1.73
Average of four Illinois coals	11.51	31.81	43.46	13.22	10,651	12,039	49.6	56.1	153.2	1.66	1.47
Average of four Pennsylvania coals	3.47	19.68	67.31	9.54	13,651	14,136	71.4	74.0	141.6	1.16	1.12
Average of four West Virginia coals	2.47	32.12	60.24	5.17	14,248	14,610	77.5	79.5	149.6	1.03	1.00

*Equivalent fuel includes that used in the producer, and also the amount required to generate the steam necessary for operating the producer.

Of the four Pennsylvania coals tested, two came from the Lower Kittanning bed, one from the Lower Freeport and the fourth from the Pittsburg bed.

Of the West Virginia coals, one came from the Ansted bed, another from the Eagle, both of these being mined in the New River district; a third from the Pittsburg and the fourth from the Keystone bed.

STEAM-TURBINE POWER AND TRANSMISSION PLANT OF THE MOCTEZUMA COPPER COMPANY AT NACOZARI, SONORA, MEXICO.[1]

BY JOHN LANGTON AND CHARLES LEGRAND.

This power plant was erected to provide for a large extension in the operations of the Moctezuma Copper Company, both at its works, situated at Nacozari, and at its mines, six miles distant. The plant was planned with the aim of providing comprehensively, not merely for present needs, but for all probable contingencies, and for possible further extensions.

The duty on crude petroleum into Mexico being prohibitive, and the wood supply in the neighborhood being inadequate to furnish fuel for a steam plant of the requisite capacity, coal is the only available fuel; and bituminous coal from northern New Mexico is the nearest and cheapest to be had. Since this coal has to be hauled 750 miles by rail to Nacozari, its excessive cost required that the plant should be planned for the greatest fuel economy consistent with that simplicity in operation which is essential in a plant which must run continuously in an isolated situation, such as Nacozari, where skilled labor is frequently scarce. The cost of fuel dictated the addition of economizers to the boilers, and also superheaters to give a moderate degree of superheat.

After careful investigation and consideration of all the conditions, both local and general, it was decided to use steam turbines.

The water at Nacozari is saturated with lime salts, and deposits hard scale in large quantities in the boilers, unless it is chemically treated to replace the lime salts by sodium sulphate. In the latter case great waste is involved in blowing off the boilers to keep down the degree of concentration of sodium sulphate in solution, which would otherwise cause foaming. The use of steam turbines, and the consequent absence of oil in the exhaust steam, makes it easily possible to get pure feed-water for the boilers by using surface condensers, thus transferring scale deposit from the economizer and boiler tubes to those of the condenser, where it is more easily dealt with, and where, at the lower temperature, the deposit will possibly be lessened.

In addition to the water being hard, it is also scarce in the dry season, and very turbid and full of sediment during the rains. Of necessity, in times of scarcity, and for the sake of clear water in times of plenty, the condensing water is passed over a cooling tower, the new water supplied being only that quantity needed to make up for the evaporation in the cooling tower. Whether it will be cheaper to treat this water supply chemically, or to expend labor in scaling the condenser tubes, remains to be determined by experience.

The near-by load on the power plant is about 1,000 kilowatts. This is consumed by the concentrating mill, the town lighting, and a few general service motors, and is approximately fixed in amount. The transmission load is about 500 kilowatts, and this is the portion of the load which is most likely to require extension, possibly in several directions, since the broken and mountainous character of the country, the scarcity of cheap fuel and of water of any kind, make any but transmitted power for mining operations very costly. It was therefore decided to generate power at a voltage suitable for direct transmission to the mine, having in mind also that step-down transformers would, in any case, be needed for the bulk of the near-by load, since no good site for the power plant could be found sufficiently near the concentrating mill to permit transmission of the mill power at motor-voltage.

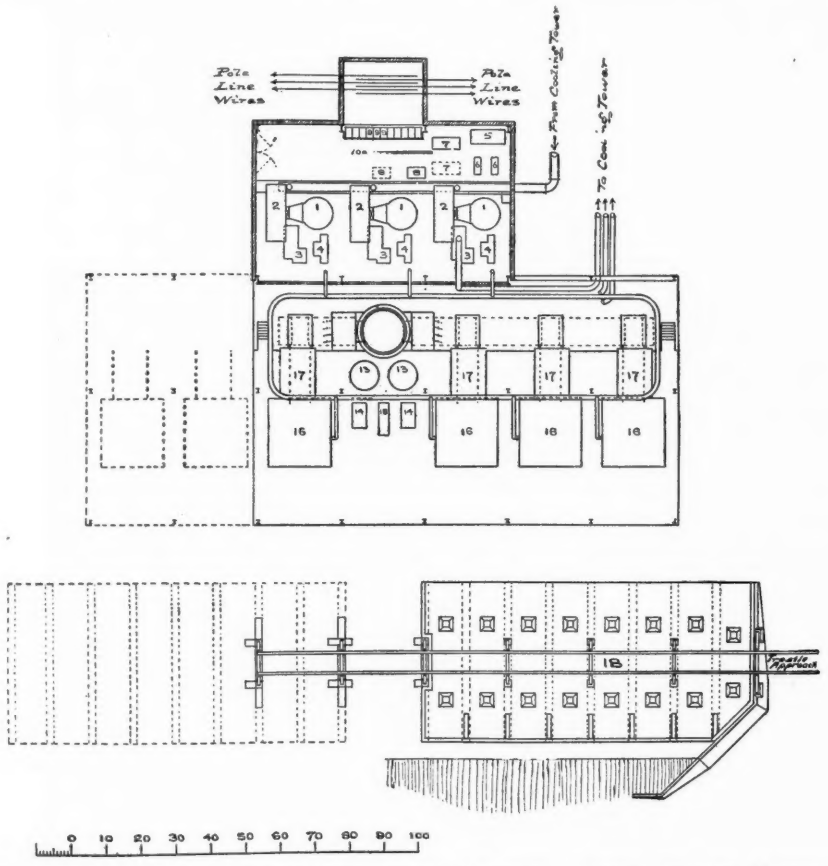


FIG. 1.—PLAN OF STEAM TURBINE PLANT OF THE MOCTEZUMA COPPER COMPANY, NACOZARI, SONORA, MEXICO.

DESCRIPTION OF POWER PLANT.

The plan and sectional elevation of the plant are shown by Fig. 1 and Fig. 2. The framework of the buildings is steel. The roofs are corrugated steel. The walls of the boiler room are also corrugated steel. The outside wall of the turbine room is concrete, and the partition between the turbine room and the boiler room is reinforced concrete.

The coal has to be hauled through that section of the semi-arid Western country where railroad traffic is subject to severe interruptions when it rains, either due to track washouts caused by cloudbursts or to the loss of bridges torn away by the débris carried along by floods in the usually dry beds of streams. To insure continuous operation of the plant it is therefore necessary to carry a large stock of coal at all times. It was considered desirable to provide storage for one month's fuel consumption. Storage by reserve stock pile entails the expense of double handling, and with bituminous coal involves deterioration, both in heat value

[1] Paper read before the Electrical Section of the Canadian Society of Civil Engineers, March 5.

and in physical character. Some form of bin storage, by which the whole stock is carried in the bins, and is continually moving through them, is therefore very desirable.

The form of storage adopted for this plant is that shown by the coal dock, numbered 18 in Fig. 1 and Fig. 2. The site selected afforded the opportunity of getting a trestle for main-line cars thirty-three feet above the boiler-room floor, at a cost of a spur of moderate length from the main line, and a short trestle approach, both on a four per cent grade. The trestle continues over the coal dock on a level, and twenty-four feet above the floor of the dock. This floor is of reinforced concrete, resting on a series of transverse walls. The two ends and one side of the dock have reinforced concrete walls twelve feet high. For the present the wall on the side next the boiler house is omitted, though anchorages are provided by which it may be added in the future if desired.

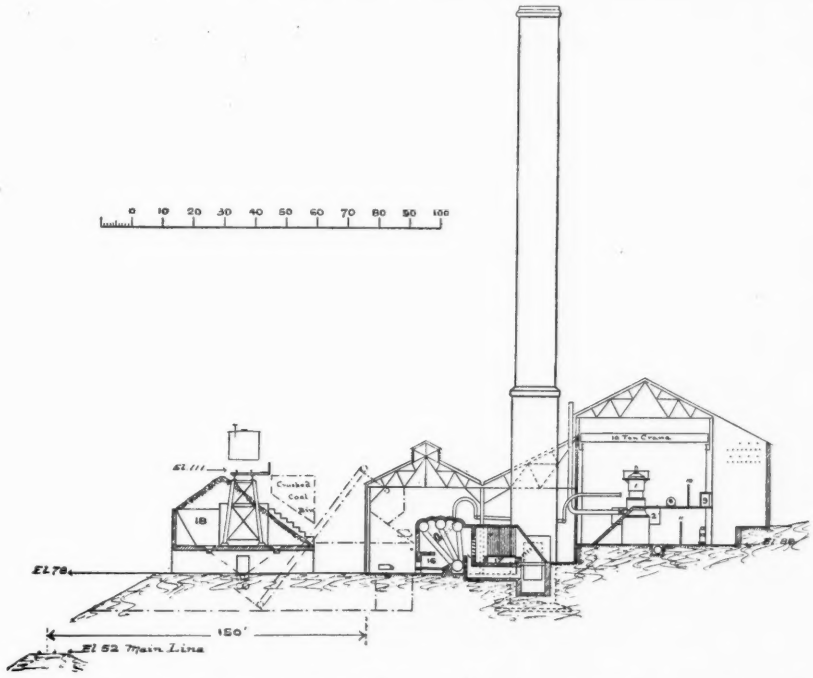


FIG. 2.—SECTIONAL ELEVATION OF STEAM-TURBINE PLANT OF THE MOCTEZUMA COPPER COMPANY, NACOZARI, SONORA, MEXICO.

The transverse foundation walls form a series of tunnels under the dock, in each of which coal may be drawn from the bottom of the pile through the hoppers and coal valves shown, fresh coal being unloaded on top of the pile direct from the main-line cars. The dock constructed holds 1,200 tons. An extension to double this capacity is shown on the plan in dotted lines.

With the fuel consumption in immediate prospect, and with the labor conditions which obtain at Nacozari, it was considered that hand-firing would at present be most economical. The coal is brought to the boilers in charge cars holding one ton of coal each, and ashes loaded by hand into small dump-cars, which are then pushed to a point where they are discharged into main-line cars on a spur from the main line, the latter being parallel to the boiler house, 150 feet distant from it, and twenty-six feet below the level of the boiler-room floor.

All charge-car and ash-car tracks are on the boiler-room floor level, and are without grade.

In case future extension and other developments make it profitable to use automatic stokers, provision is made for delivering coal to them from the coal storage dock, by means of the apparatus indicated by broken lines in Fig. 2. Coal, fed by gravity from the present hoppers to a spiral conveyer for which openings (shown in Fig. 2) are provided in the transverse walls, will be carried by the conveyer to the central transverse passage between the two coal docks. This passage will be excavated to a depth of about twelve feet below the boiler-room floor, giving space for crushing rolls, and drop enough to feed the lump coal by gravity through the rolls to the boot of an elevator. This elevator will either deliver the crushed coal to a pocket running the length of the boiler house, suspended from the roof truss, or, if it is preferred to deliver coal to the stokers by charge cars, the elevator will deliver to a small crushed coal bin. In the first case, spiral conveyers will distribute the coal along the length of the pocket, from which it will be drawn through weighing chutes to the hoppers of the automatic stokers. In the second case, charge cars filled from the crushed coal bin and weighed, will run on a platform placed at a convenient height for the cars to discharge into the hoppers of the stokers.

If desirable and profitable in the future, the excavated central transverse passage may be continued into the boiler room, and carried along the front of the boilers, under the boiler-room floor, forming a basement about twelve feet high, which will allow the use of hopper-bottomed ash-pits, discharging their contents either into cars or to a suitable ash conveyer.

Stirling boilers, Class A, are used; 435 horse-power each, with safety valves set to pop at 160 pounds gauge pressure. Each boiler is equipped with a Foster superheater, to give seventy-five degrees Fahrenheit superheat. Directly back of, and in continuation of, each boiler is a 160-tube Greene fuel economizer, sixteen rows of ten tubes wide. The gases from the economizer, or from the by-pass flue beneath the economizer, pass into the main flue, eight feet wide by nine feet high, and thence to the central stack, twelve feet inside diameter and 184 feet in height above the boiler-room floor. In addition to dampers at each economizer, and at each by-pass flue, main flue dampers are provided, one at each side of the stack, to be operated by automatic damper regulators. The boilers and economizers are set in brickwork, but all flues are of concrete, with reinforced concrete roof. The stack is entirely reinforced concrete construction.

The boiler feed-pumps are placed in the central space opposite the stack. They draw from two small tanks adjacent to them, and placed to give a suction head to the pumps. Condensed water, live steam drips, and any fresh water needed to make up feed, are delivered to these suction tanks. There are two geared triplex pumps, driven by variable speed induction motors, one in operation and one in reserve, and a duplex steam pump for emergencies. The latter is also piped to give high pressure cold water to the turbine scale borers, for scaling boiler and condenser tubes.

The main steam pipe is eight inches in diameter, and is a ring system, divided into sections by gate valves to allow repairs to piping or branch valves without

a general shut-down. All piping is overhead.

The turbine room contains three 1,000-kilowatt Curtis turbo-generators. They run at 1,800 revolutions per minute, and are three-phase, sixty-cycle, 6,600-volt machines. One turbine is always in reserve. Each turbine has its own condenser, air-pump and circulating pump.

The condensers are counter-current Alberger surface condensers, with a motor-driven dry vacuum pump. By carrying the condensed water drain pipes a short distance outside the building to a seal tank, a sufficient difference of elevation is obtained to give a barometric column. This obviates the necessity of a condensed water pump at each condenser. Two simple low-lift centrifugal pumps, motor driven, are provided at the seal tank to return the condensed water to the feed-pump suction tanks in the boiler room. One centrifugal pump is in operation and one always in reserve.

The circulating pumps are of the Root or Connersville impeller type. They are motor driven, and handle 3,000 gallons per minute each.

The cooling water tower is placed on a tableland, which begins about 100 feet back of the power plant, and which is fifty-five feet higher than the boiler-room floor level. It is of the open atmospheric type, which is found very satisfactory in the dry, western climate, where, for the greater portion of the year, the relative humidity is about thirty per cent.

A twenty-four-inch cast-iron pipe, 150 feet long, carries the circulating water from the cooling tower sump to the turbine room, along which it runs with a branch to each condenser. The valves in these branches are the only ones in the circulating water system. The elevation of the cooling tower sump gives a static head of thirty-five feet at the condensers; the circulating pumps draw from the condensers, and each pump delivers through its own sixteen-inch pipe, opened at the top of the cooling tower, fourteen feet above the level of the water in the cooling tower sump.

The turbines and condensers are set high enough above the floor to give head-room under the pipes, draining water from the condenser, and oil from the footstep bearings of the vertical turbines. This sets the operating gallery for the turbines at twelve feet above the floor. In the middle section of the turbine room this gallery is continued to the back wall of the room, and carries the main switchboard and a fifty-kilowatt motor-driven exciter, with space for a second identical exciter. A feeder from the main high-tension switchboard supplies three seventy-five-kilowatt station transformers placed under the gallery, which furnish 230-volt current to an adjacent distributing switchboard, whence wires, run on the underside of the gallery floor, supply all the motor-driven station apparatus and auxiliaries.

The circulating pumps and air-pumps are on the main floor, as are also the oil filter and the two steam-driven oil pumps which supply the turbines, and a steam turbine-driven fifty-kilowatt exciter; space is provided for a second steam-driven exciter.

The overhead crane will reach all machines, and carry them to or from a truck or car which may be run into the building in the vacant floor space left for that purpose. The station transformers under the gallery are alone out of reach of the crane, and they therefore stand on small trucks, that they may be wheeled out into a space accessible to the crane.

The pole-line wires pass out from the lean-to behind the switchboard, which contains the arrangement of wires for connecting any pole-line wire to any feeder panel, and also the lightning arrester and choke-coil system.

Normally, the plant is run with motor-driven auxiliaries throughout, but in starting up, or in case of accident to the station feeder or the transformers, the steam-driven boiler feed-pump and the steam-driven exciter enable the plant to operate with the turbine on open-air exhaust, each turbine having its own atmospheric relief valve and open-air exhaust pipe.

The turbine room exemplifies the concentration of power which is possible with steam turbines; the three 1,000-kilowatt machines with condenser and auxiliaries, and with switchboards and exciters, being comfortably housed in a floor space forty-five feet by seventy-two feet; practically one kilowatt per square foot.

The four boilers at present installed are for the immediate load of 1,500 kilowatts; three boilers under steam and the fourth a spare, for cleaning and repairs. One or two more boilers, depending on what the load-factor and the peak-loads of the increased consumption may prove to be, will be needed to bring the boiler plant up to the full capacity of two turbines. An extension for two or more boilers is shown by dotted lines in Fig. 1.

ELECTRICAL DISTRIBUTION.

As stated previously, the load consists of a few scattered motors, the town lighting, the concentrator and the mine motors and lights.

The feeders are all of bare half hard-drawn copper wires, spaced twenty-four inches apart, except between the transmission line and the mine.

Where transformers are operated in parallel, or are likely to be operated in parallel in the near future, they are provided with a primary oil switch and a secondary knife switch. These switches are located near each other so that a simple mechanical interlocking arrangement is used to prevent secondary switch being left closed when primary switch is open. This locking device permits the opening of secondary switch with primary switch closed, but secondary switch can not be closed if primary switch is open, or primary switch opened without first opening secondary switch. This device is used to prevent a man working on transformer from forgetting to open secondary switch.

CONCENTRATOR.

The house which contains the transformers for furnishing current to the concentrator motors and lights is a two-story fireproof building, twenty feet by thirty-two feet, with concrete walls, steel trusses and corrugated iron roof. The floor, made to stand a load of 1,000 pounds per square foot, is the so-called multiplex plate (a corrugated steel plate with a special form of corrugation) filled with concrete. The building is provided with two forty-eight-inch adjustable ventilators and the necessary openings in the floor and lower walls to insure a good circulation of fresh air in both stories.

The ten 125-kilowatt transformers are located in the upper story, and are connected in groups of three on each phase; the tenth transformer is a spare one, which can be connected to any of the three phases.

The high-tension wires, after passing through choking-coils, are run on insulators on the bottom chord of roof trusses. Low equivalent lightning arresters are connected to each wire where it enters the building.

The primary of each transformer is connected to its proper phase through an automatic two-pole oil switch and two single-pole disconnecting switches. The secondary of each transformer is connected to the distributing switchboard busbars through a two-pole knife switch with enclosed fuses. The primary and second-

ary switches are interlocked as explained above.

The secondary wiring between transformers and switchboard bus-bars is arranged to give as nearly as possible an equal load on each transformer connected to the same phase.

The distributing switchboard is located in the lower story, where there are no high-tension wires, and consists of eight panels of black enameled slate, on which are mounted sixteen three-pole feeder switches with fuses.

Three transformers in parallel were used on each phase, instead of a single one, for several reasons:

(1) The transformers had to be self-cooling to reduce attention to a minimum.

(2) In case of trouble with one transformer, the operation of the concentrator would hardly be interfered with.

(3) Greater ease of handling.

(4) Figuring on having a spare unit, which is necessary when plant is so far from manufacturers and continuous operation is of the utmost importance, the total cost is smaller.

These advantages more than balance the slightly decreased efficiency and difficulty of maintaining an equal load on transformers connected in parallel.

The transformer house is situated as nearly as possible at the centre of the load and over half of the load is within a 300-foot radius.

The motors connected to these transformers consist of four 150-horse-power, one seventy-five-horse-power, five fifty-horse-power, one thirty-horse-power, eight twenty-horse-power, five ten-horse-power, and nine five-horse-power, also the equivalent of about 1,000 sixteen-candle-power lamps. Two fifty-horse-power and the seventy-five-horse-power and thirty-horse-power motors are to run for ten hours a day, the other motors run continuously.

Inside of the building, where it would not necessitate too large a cable, three conductor cables were used instead of three single wires.

The secondary distribution was made at 220 volts instead of 440 volts to permit the use of incandescent lamps on the same feeders as the motors, and also to reduce the trouble with insulation, a concentrating mill for copper ore being a very wet building.

MINE.

The power is transmitted to the mine at Pilares, five and one-half miles from Nacozari, by a line consisting of three No. 2 wires spaced thirty-two inches apart, mounted on porcelain insulators suitable for 20,000 volts. The poles are of Michigan cedar with six-inch tops, spaced at an average distance of 130 feet.

The transmission line has been operated at 6,600 volts and twenty-five cycles from another power plant, and in three years' operation has not given any trouble from lightning or other causes, although a great many insulators are broken by being used as targets for revolver shooting.

At Rosario, three and one-half miles from Nacozari, are located three ten-kilowatt transformers with necessary switches and lightning arresters. They are used to operate a motor-driven pump delivering water against 600 feet head, to a tank at Porvenir. A part of this water is used for steam locomotives operating on the railroad between the mine and the concentrator; the rest is pumped 700 feet higher to Pilares for domestic use.

At a point five miles from Nacozari the line divides in two branches, one going to the Pilares shaft, the other to the Y shaft. At Pilares are located three fifteen-kilowatt transformers for lighting and power circuits on the surface and in the mine. At the Y shaft are located two 300-kilowatt, six-phase, 260-volt rotary converters, one 150-horse-power, 220-volt induction motor driving a compound air-compressor and three fifteen-kilowatt transformers for lighting and power circuits on the surface and in the mine; these transformers operate in parallel with those at Pilares, their circuits being connected through the mine workings, and both sets are provided with primary and secondary interlocking switches.

The air-compressor is belt-driven, and delivers air at 100 pounds pressure for the operation of air drills in the mine.

The direct current from the rotary converters is used to operate electric locomotives in the mine and on the surface, two electric hoists, one at the Y shaft, the other at Pilares shaft, and one stationary motor at Porvenir driving pump mentioned previously.

The electric locomotives in the mine consist of three ten-ton locomotives for thirty-six-inch gauge, of which any two are operated in tandem from one controller by means of cable connections; they are equipped with air-brakes. This tandem arrangement was used in preference to a twenty-ton locomotive, because when the use of a twenty-ton locomotive became necessary, a ten-ton locomotive was already in service. It was also difficult to get a twenty-ton locomotive for the narrow gauge and with the necessary clearances to operate in mine tunnel. It also gave a spare half unit corresponding practically to a whole spare unit.

The trolley pole is of the "scissors" type, with a roller two feet long instead of a wheel, capable of eight feet vertical motion as the locomotives have to operate outside of the mine in the same yard with the steam locomotives. This trolley pole has no lateral motion. The trolley wire in the mine is eight feet from the rails, the tunnel in which locomotives run being large enough to give clearance to thirty-ton double-truck steel ore cars. These cars are loaded at bins in the mine, and after loading are passed under a timber gauge which limits the height of the ore so as not to interfere with the trolley wire.

The hoists at the Y and Pilares shafts are duplicate as far as the electrical equipment is concerned. They are designed to lift an unbalanced load of 5,500 pounds at a speed of 525 feet per minute with 250 volts at the motors; with an unbalanced load of 3,000 pounds, the hoisting speed to be 600 feet per minute.

The hoists are double-drum geared hoists, which can be operated balanced or unbalanced, each drum being driven independently of the other by means of clutches.

The Y shaft hoist is a new one, with motors mounted on same bed plate as the drums.

The Pilares hoist is an old steam hoist which has been operated electrically for the past three years. The motors in this case are set outside the hoist frame on independent foundations and geared to the crank discs of the steam engine, crown gears having been shrunk and keyed on the discs. The connecting rods and eccentric straps of the steam engine are disconnected, but can be reconnected again in a very short time to run the hoist with steam. This has been done only once, not because of trouble with the electrical equipment, but through the lack of power at the generating station.

The motors are two compound-wound street-railway motors, rated at sixty-eight horse-power for one-hour run, geared directly to the secondary shaft of the hoist. They are operated in series-parallel by means of a drum controller giving five positions with the motors in series and four positions with the motors in parallel. The change from the series to the parallel connections of motors is done by the bridge method, which does not open the circuit, and gives a practically constant torque during the change. This prevents jars on the hoist cables.

The rheostats are of ample carrying

capacity and their resistance is so proportioned that with a light load, such as two or three men, the acceleration is not unpleasantly fast; with the maximum load the hoist does not start until the second step of controller is reached.

Compound instead of series motors were employed, to allow the motors to be used as generators, and act as brakes when lowering men into the mine. Although series motors would also act as generators under the same conditions, they would have to attain too great a speed before "picking up," and then would give a too quick retardation. When used as generators, the shunt winding of the motors is excited from the outside circuit, and the current generated by the motors is passed through their series winding to excite the field in the same direction as the shunt winding. This is done so that if the outside current fails while lowering, the cage accelerates a little, but is not completely deprived of electric brake. The current generated by the motors is passed through the starting rheostats. There are seven steps on the controller; on the first one the motors are short-circuited without rheostat, then the resistance is gradually increased to a maximum, the increased resistance corresponding to an increased speed. The maximum resistance is such as to limit the lowering speed of a full cage of men to a set maximum speed which can not then be exceeded. The first step of the controller gives a speed of about sixty feet per minute with a cage full of men.

The lowering of men into the mine is the most important work of this hoist; its operation is the reverse of the ordinary steam hoist. With a steam hoist the men are lowered "on the brake" and the steam kept as a reserve to stop the hoist in case of accident to the brake, while with the electric hoist, the hand-brake is kept in reserve.

When changing the hoist from steam to electricity, all but one of the operating levers were kept the same as before, even the reversing lever of the engine being used to operate the reversing switch of the controller. The lever operating the controller was the only one changed from the one operating the throttle, but the controller was made to operate with a regular lever as nearly as possible the same as the throttle valve instead of the regular controller handle. This was done to prevent, as much as possible, false motions on the part of hoisting engineers.

This hoist has been in operation for three years, and has worked very successfully. Outside of a set of new pinions, armature bearings, and controller contact fingers, there have been no repairs to the electrical equipment, the commutators not even having been turned once. The acceleration is very smooth, and the electrical braking is a marked improvement over the hand braking. These results are, to a great extent, due to the use of motors and controlling apparatus of generous size for the work to be done.

It may be interesting to give some tests of running efficiency of this hoist, obtained from the electric input of motors to total load lifted. The gears on the hoist itself are cast gears uncut, but worn smooth by several years of service. The weights given are only approximately correct, but error is not over three per cent. The tests were taken when running unbalanced; the efficiency would be somewhat lower when running balanced, the friction being greater for the same total load lifted.

Total Load. Pounds.	Hoisting Speed. Feet per Min.	Electrical Input. E. H. P.	Efficiency. Per Cent.
1,300	656	46.6	55.3
1,450	653	48.3	59.4
1,900	634	60.0	60.8
2,100	622	66.6	59.4
4,100	586	107.0	68.0

With average care in starting, such as given by the Mexican hoisting engineers, the starting current does not exceed the running current by more than twenty-five per cent.

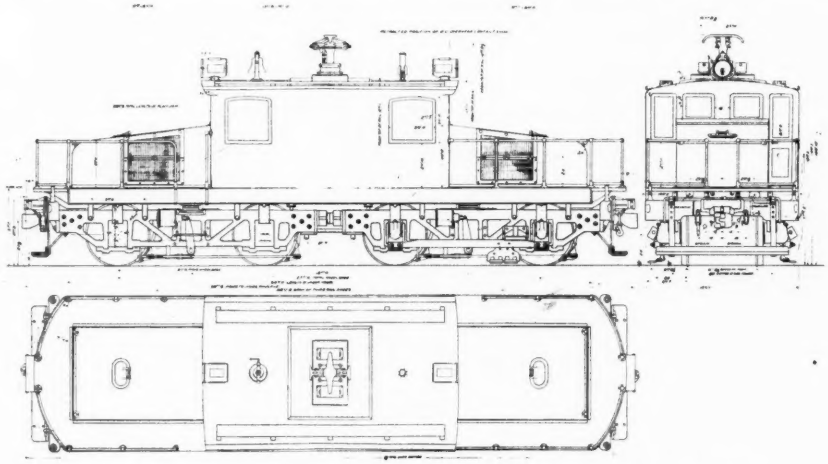
REFERENCE NUMBERS TO APPARATUS SHOWN IN FIG. 1 AND FIG. 2.

1. 1,000-kilowatt turbo-generator.
2. Surface condenser.
3. Circulating pump.
4. Dry vacuum pump.
5. Oil filter.
6. Oil pump.
7. Fifty-kilowatt steam-turbine exciter.
8. Fifty-kilowatt motor-driven exciter.
9. Oil switch cells.
10. 6,600-volt main switchboard.
11. 230-volt station switchboard.
12. Seventy-five-kilowatt station transformers.
13. Feed-water tanks.
14. Motor-driven feed pump.
15. Duplex steam feed pump.
16. 435-horse-power boiler.
17. 160-tube economizer.
18. Coal dock.

Electric Locomotives for Detroit River Tunnel.

The accompanying illustrations show one of the six electric locomotives now being built for the Detroit River Tunnel Company by the General Electric Company and the American Locomotive Company. These locomotives will be used to haul both passenger and freight trains through the tunnel now being constructed under the Detroit River from Detroit, Mich., to Windsor, Ontario.

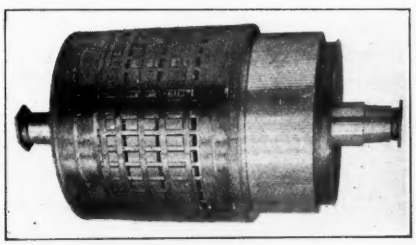
They are moderately slow-speed machines and weigh 100 tons on the drivers. The frame is of the articulated type and can best be described as consisting of two four-wheel trucks hinged together. The trucks are of a very solid construction, with cast-steel side frames of truss pattern carried on semi-elliptical journal-box springs. The diameter of the driving wheels is forty-eight inches. The draft rigging is carried directly on the outer end frames of each truck, the two trucks being hinged together by substantial hinges and pins. By adopting this method of construction the draft of the locomotive is carried directly through the truck frames and the centre pins are relieved of all hauling strains.



PLAN AND ELEVATION OF ELECTRIC LOCOMOTIVE FOR DETROIT RIVER PROJECT.

The superstructure consists of a main

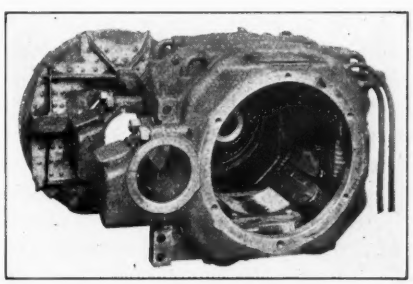
operating cab and two auxiliary end cabs. The main cab is fifteen feet six inches in length and contains the engineer's operating mechanism and valves, while the contactors, rheostats and air reservoir are contained in the auxiliary cabs. The height of the end cabs is such as to permit the engineer to obtain a good view of the tracks. Easy access to the couplers is provided by a narrow platform running



VIEW OF MOTOR ARMATURE.

from the main cab to the ends of the locomotives.

The electrical equipment of each locomotive consists of four GE-209 motors and the Sprague-General Electric multiple-unit train control. Each motor will develop approximately 300 horse-power, and at its hour rating will develop a tractive effort of 9,000 pounds at a speed of twelve miles per hour, while a complete locomotive is capable of hauling a 900-ton train up a two per cent grade at the



SIDE-VIEW OF MOTOR FIELD.

required schedule speed. The motors are of the commutating-pole type, and are among the largest units of this type yet constructed for railway work. The current will be supplied to the motors from an inverted third rail at a potential of 600 volts. On account of the heavy torque developed, which amounts to 4,050 pounds at a one-foot radius, a pinion is mounted on each end of the motor shaft.

The motors will be cooled by forced ventilation, a blower having a capacity of 2,000 cubic feet per minute being installed in the main cab for this purpose. A separate compressor, of type CP-26, with a capacity of 100 cubic feet per minute piston displacement, provides air for operating the air-brakes.

Electrical Equipment for the Santos Dock Company, Santos, Brazil.

The Companhia Docas de Santos (Santos Dock Company), through whose docks most of the coffee exported from Brazil passes, has recently placed a large order with the General Electric Company for the complete electrical equipment of its substation and docks at Santos. The order is comprehensive and includes six 3,000-kilowatt, water-cooled, three-phase, sixty-cycle, 40,000-6,600-volt transformers, twenty-three-panel switchboard and the necessary cables and wiring supplies. The order also includes five fifty-light constant-current transformers, 208 series arc lamps, 420 multiple arc lamps, a large number of induction motors for operating air-compressors, hoists, cranes, etc., and a large number of type H oil-cooled transformers.

Besides furnishing power for the docks, the substation will also supply energy for light and power to various other enterprises thereabout. Power is supplied at a line potential of 40,000 volts by a hydroelectric plant some thirty-five miles from Santos, the equipment of which was furnished by the General Electric Company two years ago.

American Museum of Safety Devices.

The opening exercises of the Exposition of Safety Devices, at the McGraw Building, 231 West Thirty-ninth street, New York city, will be held on Saturday afternoon, April 11, at three o'clock, under the auspices of the American Museum of Safety Devices and Industrial Hygiene. There will be a private view of the exhibits at the museum. Charles Kirchhoff, chairman of the committee of direction, will preside. The speakers will be Walter C. Kerr, Professor Charles E. Lucke, Professor F. R. Hutton, Dr. Josiah Strong and T. Commerford Martin.

The exposition will be open to the public on and after April 13. Among the exhibitors are the Carnegie Steel Company, Westinghouse Air-Brake Company, American Bridge Company, Union Switch and Signal Company, Yale & Towne Manufacturing Company and the Travelers' Insurance Company. Three gold medals will be awarded for the best devices in transportation and mining, and the best safety device for motor-boats and motor vehicles. Dr. William H. Tolman is director of the museum.

The Bristol Company.

The Bristol Company, of Waterbury, Ct., has come under the control of Professor William H. Bristol, whose inventions the company has been manufacturing since it was first organized in 1889. Professor Bristol assumed active charge of the management of the business on Friday, March 28, and now owns the majority interest. The business which has been carried on under the personal name of William H. Bristol, at New York, will hereafter be combined with the Bristol Company. By this consolidation of interests the Bristol Company will have a most complete line of recording instruments for pressure, temperature, electricity and for a great variety of other applications.

The Bristol Company was organized in 1889, under the name of Bristol's Manufacturing Company, to manufacture the Bristol pressure gauges and Bristol steel belt lacing, for which William H. Bristol had taken out patents. To these were added many other inventions from time to time, and in 1894 the business was incorporated under the name of "The Bristol Company."

Professor Bristol withdrew from the presidency of the company two years ago, and since that time he has developed a number of new inventions, including the William H. Bristol electric pyrometers and patented smoked chart recorders. These have come into wide use. He has taken out a number of patents during the last three years on new instruments. One of these, which will soon be put on the market, is the long-distance electric thermometer, designed especially for indicating refrigeration, atmospheric and drying temperatures. This instrument will fill a want long felt where it is desired to indicate at some central station, by means of switches, the temperatures of several different points.

The new lines of William H. Bristol instruments supplement those of the Bristol Company, supplying a variety for applications for which the old instruments could not be recommended. For example, the standard Bristol recording thermometers can not be successfully used for temperatures above 600 degrees Fahrenheit, while the William H. Bristol pyrometers are being applied to great advantage for higher ranges, especially from 600 to 2,600 degrees Fahrenheit. The new lines of William H. Bristol pyrometers are fitted with special movements made by the Weston Electrical Instrument Company, and are designed for extremely accurate measurements.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The First Cost of Steam Turbines.

It has recently been stated by Stevens and Hobart that as yet the steam turbine is more expensive than a piston engine. This statement was contradicted in a recent paper read before the Manchester (England) Association of Engineers by S. L. Pearce, who submits a table showing the relative prices paid for turbines and piston engines during six years. In 1900 contracts were entered into for 750-kilowatt generating units at a price of $40 a kilowatt for the piston engines and $21 for turbines. These figures do not include condensing plant nor other steam accessories. The complete contract for generators, piston engines and condensers was at a price of $51.50 a kilowatt; for the turbine equipment it was $41.75. These prices also apply to the year 1904. In 1889 and 1901 contracts were entered into for 1,800-kilowatt generator units at $30 a kilowatt for the piston engine, and $21.75 for the turbine, as before, without accessories. The prices for the complete generating equipment, including generators, condensers, etc., was $50 for the piston-engine unit, and $40 for the turbine unit. In 1901 a piston engine for a 1,500-kilowatt unit was purchased at $26.50 a kilowatt. In 1902 a 3,750-kilowatt piston engine was purchased at $33.25 a kilowatt, and in 1906 a 6,000-kilowatt steam turbine was purchased at $13.25 a kilowatt. The last three rates do not include steam accessories.—*Abstracted from the Engineering Times (London), March* 19.

The Price of Electric Power in Sweden.

The city of Gothenburg, Sweden, has recently contracted for a large supply of electric power from the water-power plant at Trollhättan, a plant being constructed by the Swedish Government. The contract calls for the delivery of power at the city limits as three-phase current at a frequency of twenty-five cycles a second, 6,000 volts. The price agreed upon is $13.75 a year per kilowatt of maximum demand for the first 7,000 kilowatts taken, plus 0.134 cent per kilowatt-hour for power used. This would make the cost of one kilowatt used for 2,400 hours during the year $17.08. If used for 7,200 hours the cost would be $23.80. If more than 7,000 kilowatts are taken by the city, the fixed yearly price will be raised twelve per cent for the amount in excess. The maximum demand is to be ascertained by a meter which shows the highest load during a quarter of an hour, the instrument to be read every week, and the mean of the four highest readings to be considered as the maximum demand during that period. The rates at which the city will supply power to its consumers have not yet been determined upon, as the distribution will not commence until January, 1910. The Trollhättan plant makes use of waterfalls on the Gota River, forty-four miles north of Gothenburg. The plans call for an equipment of eight 7,000-kilowatt generators, four of which have been ordered from a Swedish company. Power is to be transmitted from the station at 55,000 volts on steel towers, the spans being from 500 to 600 feet. For building the plant $3,105,000 has been appropriated and $687,500 is estimated as the cost of the transmission system.—*Abstracted from the Electrician (London), March* 20.

Transatlantic Wireless Telegraphy.

During a recent discourse on wireless telegraphy Marconi gave a brief historical review of the work of his company in establishing communication across the Atlantic Ocean. On March 24, 1899, he sent his first message across the English Channel. In January, 1901, he established communication between Cornwall and St. Catherine's Point, Isle of Wight, and thus demonstrated clearly that the curvature of the earth did not cut off the waves, as to clear it a tower more than a mile high would have been needed, while the towers used were only 300 feet high. On December 11, 1901, by means of kites sent up from Newfoundland, Marconi succeeded in catching a series of signals sent out from Poldhu, in Cornwall. In February, 1902, Poldhu kept in communication with the steamship Philadelphia, sending messages up to a distance of 1,551 miles and signals for 2,099 miles. These experiments brought out the injurious effects of sunlight on the electric waves. In December, 1902, communication was established between Glace Bay, Nova Scotia, and Poldhu, and in the spring of 1903 the transmission of press messages was begun, but was interrupted by several accidents and was not resumed. In October, 1903, messages were sent from Portsmouth, England, to Gibraltar, a distance of 1,000 miles, 500 of which were over land. During the next few years, changes were made in the forms of the aerials, and one having a more or less directional effect was adopted. In May, 1907, a new station at Clifden, Ireland, was erected and equipped with powerful apparatus, and the transmission of press messages was begun on October 17 of that year. Simultaneously with these experiments Marconi devised a new system of continuous or semi-continuous trains of waves, which was tried between Poldhu and Glace Bay with success and was adopted at Clifden station. The apparatus consists of a large disc driven at a high speed by a steam turbine or electric motor. The periphery of this runs between two smaller discs of steel about eighteen inches in diameter, which turn slowly in a plane at right angles to the first. These two discs are connected in a circuit with two condensers, which are maintained charged at a high potential by a high-tension, direct-current dynamo. At a point of the circuit between the two condensers a branch circuit is carried off which contains a condenser, an oscillating coil and a large revolving disc. When the condensers are charged and the large disc is driven at a high speed, a spark will pass between this disc and one of the smaller ones, and oscillations are set up in this way with a frequency as high as 200,000 per second. It was found that if the disc be rotated slowly, an arc would be formed between this and one of the side discs. It is thought that the cooling effect due to the high speed prevents the arc and causes the discharge to take place merely as sparks. It was found, however, that these oscillations were of too high a frequency to affect the magnetic detector, although a synchronous coherer would work. But better results were obtained by placing a series of knobs on the large revolving disc, which had the effect of causing the

sparks to take place at definite intervals, thus producing a succession of undamped, or slightly damped, waves, which set up a musical note distinguishable in a telephone receiver. One advantage of this is that there is no confusion between these musical signals and noises due to atmospheric electricity.—*Abstracted from Engineering (London), March 20.*

The Development of the Flameproof Motor.

The use of the electric motor in mines where fire-damp exists has made it necessary to develop a machine which could be ventilated and at the same time would not set fire to gases outside of the motor case. Motors have been used in tight cases, no ventilation being provided for, but such machines necessarily run hot and have a comparatively limited output. The obvious remedy for this trouble was to provide suitable openings in the case, which should be covered with wire gauze, using the principle of the Davy safety lamp; but this arrangement has not proved satisfactory, for when a large amount of gas is drawn into the motor, a spark may explode it and the gas continue to burn there for some time, eventually damaging or destroying the motor. To provide a more satisfactory means of protection extensive tests have been conducted at the Gelsenkirchen Fire-Damp Research Station, Westphalia, Germany. It was thought at the same time to devise a more substantial protection than afforded by the wire gauze, which is easily torn. The preliminary tests were made with tubes covered with gauze, but this was found to be open to the objections just mentioned. In one case the gas continued to burn within the motor for fifteen minutes. Five types of screen were then devised, one of which was found to be much more satisfactory than the others and to have extremely good ventilating properties. An explosion could not be transmitted through it, and after-burning did not take place. This consists of a number of hollow circular or rectangular metal sheets built up one above the other with narrow air-spaces between them. The sheets should be of brass or other non-rusting metal. When applied to a motor it is convenient to place three such protectors on the case, one at the top in the stator housing, the others in the end brackets. The leading-in wires should be attached to a terminal box, which is sealed up with insulating compound after all connections have been made. This is to render the motor thoroughly air-tight except for the protected openings. A motor of fifty horse-power, for 1,000 volts, built in this way has been subjected to exhaustive tests at the Frameries Fire-Damp Research Station in Belgium. The chamber was filled with explosive gas containing six, eight and finally ten per cent of methane. The mixture was ignited in the interior of the motor by a spark from an induction coil, but in no case was the explosion transmitted to the gas surrounding the machine, though the test was repeated many times. As a further test, guncotton was exploded within the motor, but in every case failed to produce an explosion outside. The motor itself suffered no damage in any of these tests. Motors protected in this way should be rated as half-enclosed machines, and in order to supplement their natural ventilation, fans are attached to the shaft, which draw air through the protected openings in the brackets and expel it through the protector over the stator housing. The effect of this ventilation is that the output is only twenty-five per cent less than that of the open-type machines of the same size. The starting switches for these machines must also be protected, since they are usually placed near the motor. For alternating-current motors, submerging the controller in oil gives good results, but it is better to use the type of protection employed on the motor for direct-current controllers, since the direct-current arc is less easily extinguished under oil.—*Abstracted from the Electrician (London), March 13.*

A New System of Former Winding for Semi-Enclosed Slots.

A description is given here of the method devised by F. Creedy for winding generator coils in forms of such shape that they may be inserted directly in semi-enclosed armature slots. The method usually employed for placing windings in such slots is to draw the wire in by hand, but this is a slow and costly method and calls for two windings and is apt to damage the wire while the work is being done. Its advantages are that it enables the slot to be filled tightly and does not require highly skilled labor. It was to avoid the objections to the hand-winding, and yet to enable the advantages of semi-enclosed slots to be retained, that the new type of coil was devised. In winding this coil it is sought to arrange the conductors so that those parts which lie in the slots where space is most valuable and repairs most difficult should be completely insulated and protected before leaving the former, and, if possible, the coil should not need any change of shape after leaving the form. When this can not be avoided it should be merely the ends of the coil which are altered, not the active length. It should also be possible to use insulating tubes for high-potential generators. The coils should be of such shape that they can be removed for repairs and replaced. The principle of the new winding consists in bending up the end turns in the direction of the air-gap and in such a way as to bring all the wires into one plane, which enables them to pass through the narrow slot opening. In order to do this the coil is clamped after being wound in the former, and one side of the latter is then removed and a rod placed across the side of the coil and clamped in position. Then the under layer of wires is bent up at right angles to the plane of the coil, the turns all being held in the same plane. The rod is slipped back and the next layer of wires from the bottom is bent up so that these wires fall behind the first lot, and so on until all layers have been bent up at right angles to the plane of the coil. These wires may then be bent slightly in or out so as to bring them all into one plane. The coil is thoroughly taped and insulated and is ready to be placed in the slots. With this arrangement, since all of the turns lie in one plane and are bent up so as to clear the teeth, it is obvious that the coil can be slipped into position without any further change. When in position the turns may be left as they are or bent down, as may be desired. If they are not bent, their position, of course, makes it possible to draw out the armature in one direction only. To facilitate the insertion of the coils the following method is adopted: Assuming a four-pole winding with a pitch of five, the first coil is then placed in slots one and six, the second coil in slots seven and twelve, and not in slots three and eight as would usually be the case. After four coils have been placed and the armature has been gone around once, the fifth coil is then placed in slots three and eight, and the same method followed. In this way each coil may be easily removed by simply removing the coils which lie above it. Coils wound in this way may be insulated by tape or the insulation may take the form of a lining in the slot. In the latter case it is preferable to place the insulation on the coil and insert it in the slot with the coil.—*Abstracted from the Electrical Review (London), March 20.*

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

Marion, Ind., and Some of the Progressive Methods Which Have Caused It to Be Known as The Electric City.

The amount of boosting which a live electric light company can do for the city in which it operates is enormous. Notable examples of this have been given from time to time. The case of Denver, Col., is a well-known one. Progressive management and a square-deal policy with the people in that city on the part of the electric light company earned for Denver the proud title of "The City of Lights."

What has been done on a large scale in Denver, Chicago and other large cities is being done to-day in some of the smaller but none the less hustling cities of the country, and one notable case is that of Marion, Ind.

This beautiful little city of 25,000 or 30,000 population is known throughout the state as "The Electric City of Indiana," and certainly among the circle of towns which form this group, Marion stands without a peer, electrically speaking.

To the traveler who has been working that section, to land in Marion at nightfall is like striking a beautiful oasis of light after having been for long, weary days on a desert of darkness.

Marion at night is "all lit up." It has its own little "great white way." Beautiful arches of light adorn the principal street corners, public square, etc. The splendid court-house building, standing in the centre of the public square, is outlined with hundreds of incandescents. Store windows all vie with each other as to which shall be the brightest and most attractive looking after dark.

The psychological value of a well-lighted city like this can not be overestimated. The man who sees Marion for the first time is impressed with the fact that he is in a community of "live ones." When he goes away from the town, if some one happens to mention Marion, Ind., he says: "Say, fellows, it's one of the best little towns in the whole country; it's in a class by itself."

The secret is not far away. Every Marion man you meet is a booster. Every Marion woman you meet is a booster. And the boys and girls and little children, they are boosters too. They think Marion is just about the best place on the map.

But the two principal causes for Marion's fame as The Electric City of Indiana are its progressive business men, and its aggressive, hustling, "square-deal-policy" electric light company.

The key-note of the company's policy been to give 100 per cent of service for every dollar taken in; to give everybody a square deal, and to win in every possible, legitimate way the esteem and friendship of the business men and public generally. Such a policy can not fail in its results. While it is true that possibly more money might be made for a short time by other means, it is the company which builds up its business with the idea that honesty is the best policy that, in the long run, wins out far ahead of all others.

The Marion Light and Heating Company is actually one of the most popular institutions in Marion. It is entitled to this credit. S. H. Smith, the manager, seconded by his worthy lieutenant, E. T. Hollingsworth, enjoys the confidence and respect of every good business man in Marion. Merchants, newspapers, county officials and the people generally, realize that they owe to the aggressiveness and liberal policy of their electric light company an unstatable debt of gratitude.

Samples of the Direct-by-Mail Advertising Employed by the Marion Light and Heating Company.

At the same time, as Messrs. Smith and

Hollingsworth are the very first to point out, no such success could have been theirs had it not been for the generally up-to-date spirit of the business men of Marion, who have been, to a man, quick to fall in with the progressive methods and plans proposed by the electric light company.

One of the ways in which the company has made a big hit has been by furnishing special illumination during the holiday season, consisting of strings of incandescent lamps across the pavements, etc.; also by co-operating with the merchants in outlining the court-house with lights, and lighting the arches on the street corners before mentioned. You will see a great many more electric signs and electrically lighted windows in Marion than you will in many cities three or four times its size—yes, and some cities ten times its size.

The Electrical Bulletin
Published by the Marion Light & Heating Co.
Marion, Ind.
The Electrical Bulletin
Published By The Marion Light & Heating Co. Marion, Ind.
November Number
The Electrical Bulletin
Published by the Marion Light & Heating Company
Marion, Ind.

Some of the Cover Designs Used for the Monthly Bulletin of the Marion Light and Heating Company.

The spirit of hustle and "get there" permeates the whole town, and is in striking contrast to the local pride (or shame it should rather be called) of another city we know of, of about the same size, where the local merchants have an agreement to light their windows only two nights a week. In this same city, which we will mercifully refrain from naming here, the electric light company, after many exertions, succeeded in placing a couple of flaming arcs in the front of a store which was near an intersecting street. The flaming arcs were no sooner burning brightly than the city fathers had "a bright idea" and removed the arc lamp from the corner of the street to a dark spot in the suburbs, for they said, "Jones' flaming arcs will light up that corner enough without that arc lamp."

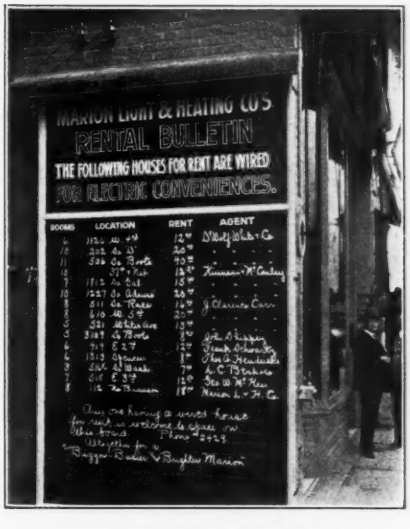
Just a word as to some of the progressive methods which are in force by the electric company in stimulating interest in electricity and in arousing and creating the demand and desire for it. In the first place, liberal use has been made of very attractive, high-grade direct-by-mail advertising. Month by month a beautiful illustrated bulletin (see illustration in this article), printed in two colors, has been sent out to customers and prospective customers with great success. The bulletin contains references to all the latest electrical devices as they come along—heating pads, chafing dishes, irons, etc.—and many very interesting items along general electrical lines are included from month to month. This makes the bulletin something which the people come to look for. It is read in the homes, the children read it, and when the father comes home at night he picks it up and reads it too. In this way interest in electricity is not only aroused among people who previously had not known much about it, but is maintained and kept up to a good standard with those who are already using electricity. They are reminded from month to month what a good thing, what a blessing, in fact, they are enjoying in living in electrically lighted homes.

In addition to this monthly bulletin, special literature of the highest grade character has been sent to stores, business places, factories, etc., telling about the advantages and business-bringing results of electric signs, window displays, well-lighted interiors, etc.

In this connection, and to further show the very modern ideas in force with this progressive company, a reproduction is made in this article of the postal card which is used in rendering statements to merchants. It will be observed that it is stamped "electric advertising." The merchant, when he gets his bill, is constantly reminded that he is paying not for light as light, but for light as "electric advertising." This is a point which is strongly emphasized by the management, and its men at all times are instructed to speak of commercial lighting as electric advertising.

The Hub—An Electric Sign Effect.

In addition to the direct-by-mail campaigns which have been used with such marked success, there has been extensive use made of other methods of publicity.



House Renting Bulletin Board Outside the Office of the Marion Light and Heating Company.

One of the very best ideas heard of in a long time is that inaugurated by Mr. Hollingsworth, which consists of a bul-

letin board listing houses for rent which are equipped for electric conveniences. Possibly Mr. Hollingsworth has not a patent on this idea, but it is certainly well thought of. A photograph of this bulletin is shown and a clipping from the Marion newspaper, which will serve to show how successful a piece of advertising this is:

PEOPLE DEMAND HOUSES WIRED FOR ELECTRICITY.

Ten days ago the Marion Light and Heating Company erected a rental bulletin board, advertising houses wired for electrical conveniences, and also placed in each house a card announcing that it was equipped for electricity. The following shows the results derived by one agent from the ad.:

MARION, IND., August 10, 1907.

Marion Light and Heating Company, City.

Gentlemen—About one week ago I gave your Mr. Hollingsworth a list of seven vacant houses for rent, which are wired for electrical purposes, to be placed on your rental bulletin board; since that time all of these have been rented except one, namely: Eight-room house, No. 1908 South Washington street, rents at $20 per month. Please add to this list, Ten-room house, No. 1903 South Adams street, rents for $15 per month.

This demonstrates very clearly to my mind that the demand is for houses equipped for electrical purposes. I appreciate very much your assistance in renting these houses.

Respectfully,
J. CLARENCE CARR.

The bulletin board was first erected last August, and since that time upward of 100 houses have been rented directly through its influence.

A notable thing, and one which shows how thoroughly Marion is electrified, is the fact that a wholesome percentage of the electrically equipped houses listed on the bulletin board are of such low rental as $7, $8, $10 and $12 per month, which is surely significant.

There are dozens and dozens of cities where one would be laughed at if one inquired for an electrically lighted house at anything less than $25 per month.

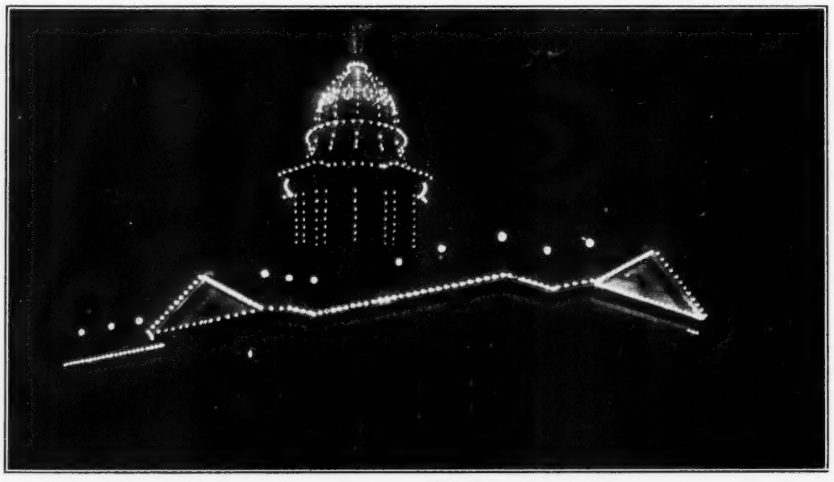
Another very good thing is the placing in houses which are for rental of a large card explaining that they are wired, ready for electrical use.

The company has placed a huge electric sign directly across the street from its office. This sign is of the talking variety and goes on every evening at nightfall to flash messages about what electricity will do for the profit and comfort of the Marionites.

Newspaper advertising is, of course, freely used, and cleverly used too. Herewith is reproduced a full-page advertisement which was issued at the time of the recent business depression. It struck a responsive chord in the hearts of all the merchants and business men in Marion, and it is safe to say helped very largely to keep the people feeling optimistic.

One of the latest newspaper advertising ideas is the getting out conjointly with the Marion *News Tribune* of a special edition of that paper devoted entirely to electricity and its uses in and around Marion. At the very head of the first page is the slogan: "All together for a bigger, brighter and busier Marion." Reference is then made to the officials of the electric light company, and on the remaining pages of the edition are illustrations and write-ups of the many concerns in and around Marion which are making effective use of electric light and power. This special edition is a winner, and Mr. Smith and Mr. Hollingsworth are to be congratulated on this promotion work.

Just a brief reference to the excellent efforts which are made to cement and foster the *esprit de corps* of the employés of this company. Weekly meetings are held among the employés, in which new-business subjects and also semi-technical subjects are freely discussed. In this way the business department learns how electricity is made, and many things in connection with the strictly technical end of the business which become useful to him in his work, while, at the same time, the engine-room men, line operators, etc., become imbued with the spirit of new-business activity, get to know what the company is doing in its relations with the public, and as a result, have become a very powerful source for good in stirring up business for the company. They plug at the game all the time.



The Marion Court-House as It Appears at Night.

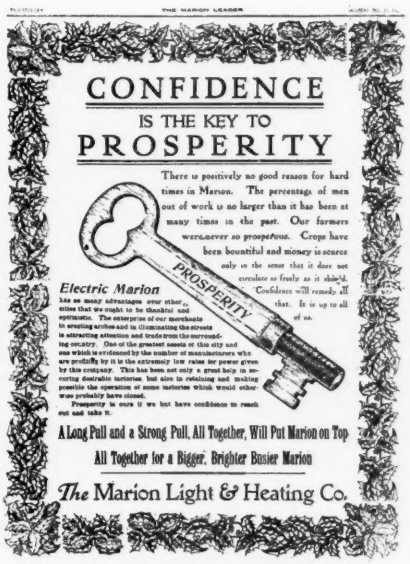
Goldthait's Department Store—An Example of Outlining.

Some remarkable things about Marion are these:

It is difficult to find a person who will complain against the electric light company.

There isn't an isolated plant in town.

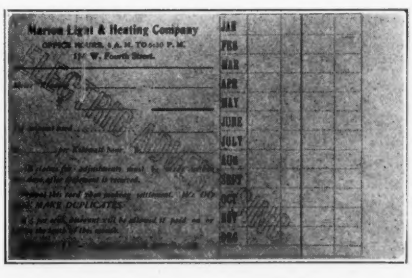
Although Marion is situated in what is known as the "gas belt," there are probably less gas arcs, and in fact, less gas illumination of any kind than anywhere that could be thought of.


CONFIDENCE
IS THE KEY TO
PROSPERITY
PROSPERITY
Electric Marion
A Long Pull and a Strong Pull, All Together, Will Put Marion on Top
All Together for a Bigger, Brighter Busier Marion
The Marion Light & Heating Co.

One of the Full-Page Advertisements Used by the Marion Lighting and Heating Company.

One of the means used to get rid of gasolene lighting plants was to offer them for sale through the newspapers at half cost for the merchant who installed electricity instead.

The announcement of ten or a dozen gasolene plants offered at less than half had a moral effect on the community, which it is safe to say could not have been secured in any other way.



The "Electrical Advertising" Postal Card.

Mr. Smith and his predecessor, George N. Tidd, well known to all electrical people as one of the foremost central station managers in this country, have been unusually successful in securing power business in Marion.

One plan which they have worked very effectively is that of adopting an especially low rate to manufacturers who will agree to use power, keeping off the company's peak load. Now this is a thing which has come up before, but there has been a tendency on the part of lighting plant managers to whom it was suggested to rather fear that it would not be practicable. This is not true. It does work out in practice. Of course, occasionally, some manufacturer wants to run on, and if it is not going to inconvenience the company too greatly, he is permitted to do so, but at the same time he is checked up every little while and reminded that he is enjoying special privileges for keeping off the peak, and in this way the privilege is not abused. The management assured the writer that it has had absolutely no trouble in enforcing this plan where it had been adopted, and in fact, had found that it worked like a charm.

Not long ago 150 people came over from Kokomo, one of the nearest towns, in a couple of cars, just to see what they were doing in Marion that had got it so talked about as being "The Electric City," and every one of that 150 went back with a determination to do something similar for Kokomo.

From now on there is going to be lots of fun seeing how these two cities rival each other, but as Mr. Smith, manager of the Marion Light and Heating Company, said, with a smile, "We are at least three years ahead of them now, and if we can't stay ahead, we don't deserve to."

A Color Scheme for Pipe Lines.

William H. Bryan, consulting mechanical engineer, of St. Louis, Mo., in *Steam* for March 15, suggests a method of identification to overcome the confusion resulting from the multiplicity of pipe lines in modern power stations. Not only would this facilitate the regular work of the attendants in charge, but it would reduce the probability of mistakes in handling valves and in times of emergency might prevent serious accidents. Furthermore, when a change of engineers was made, the new man could grasp the situation more quickly and there need not be any interruption of the service. Such a system would also be of advantage to inspectors in making regular visits.

The United States Government requires all pipe lines in distilleries to be painted in colors in accordance with an established system. Something has been done also in other power plants in this direction, but, so far as the writer knows, no complete scheme has heretofore been worked up for general adoption. He describes the scheme which he worked out in designing the power and service plant of the new Hamburger department store at Los Angeles, Cal., with 1,600-horsepower capacity. Here there were not only the usual steam, exhaust and feed lines, but a sprinkler system, iced-water distribution, air lines, both compressed and vacuum; ammonia and brine lines for refrigeration, and oil, both as boiler fuel and for lubrication. The plan evolved was adopted as follows:

Steam—
- High and medium-pressure.....White
- Low-pressure heating lines .....Aluminum Bronze
- Exhaust lines.....Gray

Hot Water—
- Returns from heating system .....Aluminum Bronze
- House supply.....Maroon
- Boiler feed.....Bright Red
- Pure drains from high-pressure and exhaust-head drips.....Pink
- Impure drips, overflows and boiler blow-offs, to blow-off tank.....Black

Cold Water—
- From city mains or deep well and general house distribution....Light Blue
- Sprinkler lines, including tank, excess pressure and draining systems.Blue

Iced Water—
- Drinking water lines..Dark or Navy Blue

Air—
- Vacuum heating and house cleaning lines.....Light Green
- Compressed .....Dark Green

Refrigerating—
- Ammonia, gas.....Yellow
- Ammonia, liquid.....Bronze
- Brine .....Orange

Oil—
- Lubricating system.....Light Brown
- Boiler supply.....Dark Brown

These colors are to be applied to the pipe lines after completion and test. They will be applied directly to the pipes themselves where they are left bare, and on top the finished covering for all others.

The pneumatic tube cash system, being of polished brass pipe, was not thought to need special coloring.

Pipe lines for hydraulic elevators when installed might be violet. Still further differentiation, if desired, could be secured by painting the valves and fittings a different color from the pipe itself.

Gas pipes, where exposed, might be left black, as there would be no danger of confusing them with impure drains.

Care must, of course, be taken to secure colors that will not fade under heat.

The above plan is believed to be consistent and reasonably complete, and is recommended for general adoption.

Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on April 14, for the following electrical supplies: 3,000 pounds electrolyte, for delivery at Brooklyn, N. Y.; sixty-four fans, for delivery at Norfolk, Va.; twelve flatirons and six soldering irons, for delivery at Annapolis, Md.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

A New Type of Induction Motor.

The flexibility and economy of the alternating-current method of power distribution have led to its wide adoption in central station service and because of the economy of the use of this central service many industrial plants are now purchasing power. The same features that led to the selection of alternating-current generation and distribution for central stations have, in a somewhat lesser degree, led to its distribution for large industrial works. On account of this it was necessary to provide alternating-current motors of varying characteristics. To meet the varying conditions imposed by high starting torque with a low initial starting current, a modified form of motor has been produced by the Westinghouse Electric and Manufacturing Company, known as the type "HF."

The general appearance of this motor is shown in the illustration, from which it will be noted that it is especially rugged and substantial. The frames are amply ventilated, but so constructed as to protect the laminations from injury. Throughout, the motors have been designed for hard service. The insulation on the coils has been very thoroughly made and will stand much greater stresses than it receives in normal service. It is furthermore so built that vibration, and consequent wear of the insulation, is prevented.

Attention is called to the brushes, by means of which connection is made to an external resistance. These bear on continuous rings of metal so that there is no occasion whatever for sparking. The brushes are liberally proportioned, so that they have long life and require the minimum of attention. The rotor is unlike the usual short-circuited type of armature on induction motors, and has a regular winding in which the resistance is inserted while starting, and thus the starting current is limited. Approximately full-load current is required to produce full-load starting torque.

Special covers are provided for enclosing the brushes where this may be desired. They may be equipped with semi-enclosing covers by which the brushes and slip rings are protected from any coarse particles, or totally enclosed preventing all dust from lodging on these parts.

Type "HF" motors are built in the usual sizes from five to 500 horse-power, with larger sizes on special order. The

TYPE 491 ALTERNATING-CURRENT MOTOR STARTER, TWENTY TO SEVENTY-FIVE HORSE-POWER.

standard frequencies are twenty-five, forty and sixty cycles, but motors for other frequencies are supplied when required.

In connection with these motors special

"HF" MOTOR WITH BRUSHES TOTALLY ENCLOSED.

starting devices are supplied by which the current at starting is varied by hand. These starters cut resistance out of the circuit of the rotating armature until the handle reaches the full-on position, when the resistance is all short-circuited and the motor runs with practically the constant-speed characteristics of the squirrel-cage armatures. A special short-circuiting switch is provided on motors of 100 horse-power or larger if desired. This relieves the brushes and the leads and contacts on the starter, as the windings are short-circuited inside the motor.

Scientific Tool-Grinding.

Sharp tools not only increase the daily output of machine shops but also improve the average quality of the work. To keep tools in first-class condition by ordinary means requires the service of an expert; consequently, various methods have been evolved to attain this end mechanically by the use of tool-grinding machines.

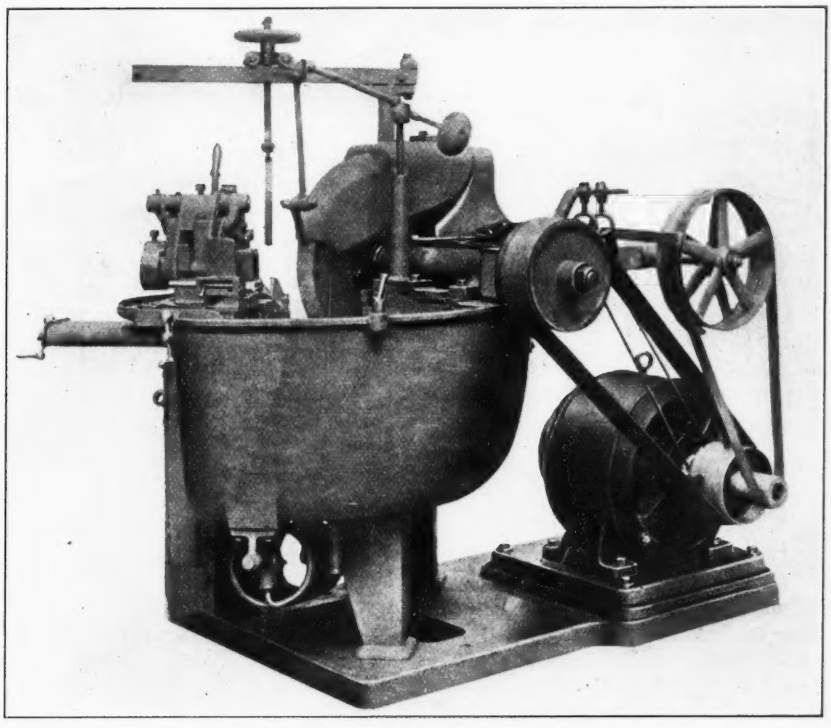
To efficiently grind steel tools by means of rapid cutting-wheels, it is absolutely necessary that the contact between the two should be a line and not a surface. Hence, if it is desired to grind a plane face of a tool, the wheel must have a cylindrical or conical surface, past which the surface to be ground must be moved in a plane. A plane face of the wheel can not be used for this purpose, because it and the surface being ground would soon coincide, with the results of no cutting and much heating.

The tool should be clamped in the holder against its base, or the surface upon which it rests when in use, in order to avoid any errors due to want of parallelism of its sides, and to enable it to be reground with a minimum of loss. All of its plane faces should be ground without altering its position in the holder, to insure accuracy of the angles and uniformity in results. This requirement is particularly important in thread tools.

The tool-holder should be capable of presenting the tool to the wheel in such manner that any face can be so ground as to have a definite, predetermined relation to the other faces and to the shank, and the adjustments necessary to accomplish this must be easily understood and quickly manipulated. It must be so mounted as to enable the tool-face to be easily and quickly reciprocated past the line of cut of the wheel, and to be re-

liably fed against it and brought to any part of it. The cuts should be light, quick and frequent, to produce the best results in the shortest time.

Experiments have demonstrated that for roughing-cuts a curved cutting edge



Allis-Chalmers Type "K" Motor Driving Tool Grinder.

is more efficient than a straight one, and that different materials and different depths of cut require different degrees of curvature; also that the cut should be a draw-cut and not a gouging-cut, so that the bulk of the metal would be removed ahead of the point of the tool. This adds greatly to its life, the point being the most delicate part.

Universal tool-grinding machines, manufactured by William Sellers & Company, of Philadelphia, Pa., such as the one illustrated herewith, which is belted to an Allis-Chalmers type "K" motor, have been designed to meet the above requirements. Heat generated by the grinding is carried off by means of a large volume of water at low velocity, which is forced to the tool by a rotary pump through a system of jointed pipes, ending in an adjustable nozzle. The use of such a large quantity of water demands that all working parts should be protected from it, on account of the grit carried along with it. This has been effectually done. In fact, every point about these machines has been carefully studied and thoroughly tried.

A NEW FORM OF COOPER HEWITT MERCURY-VAPOR LAMP.

BY F. H. VON KELLER.

One of the problems that require the serious attention of the engineer in connection with mercury-vapor lamps is the starting of the same. And it is with respect to the starting that the terms "automatic" and "non-automatic" have become descriptive of the various types of mercury-vapor lamps now on the market. The mercury-vapor lamp presents in this respect a behavior similar to the ordinary arc lamp. For, the inert vapor separating the two electrodes of a mercury-vapor lamp is by no means a conductor of electricity, until the current has been established in the vapor path by some special means. In the most extensively used type of mercury-vapor lamp, the so-called "tilting lamp," a conducting connection is temporarily formed between the electrodes by tilting the tube in such a way that the mercury is caused to flow along its entire length and forms an uninterrupted bridge between electrodes. When the stream breaks the lamp starts. The tube is then allowed to drop back into its original position by gravity.

This operation of tilting the tube is usually performed by hand. In this case it is, of course, necessary that the operator should approach the lamp and pull the chain attached to the lamp holder for this purpose. In most cases this is entirely practicable and this type of lamp has gained a wide field of usefulness.

On the other hand, this operation may be performed by means of a solenoid or an electromagnet, which renders the lamp automatic. This method is, however, for mechanical reasons usually confined to tubes not exceeding twenty-one inches in length. This type of lamp is known under the name of "automatic tilting lamp," and has also come into the market to a great extent.

In some cases it is important that the lamps be automatic: For instance, in installations where the lamps themselves are suspended at considerable height, or where for other reasons it is impracticable to have the operator approach each individual lamp for the purpose of starting. Therefore the type of lamp described in the following has been developed. Here

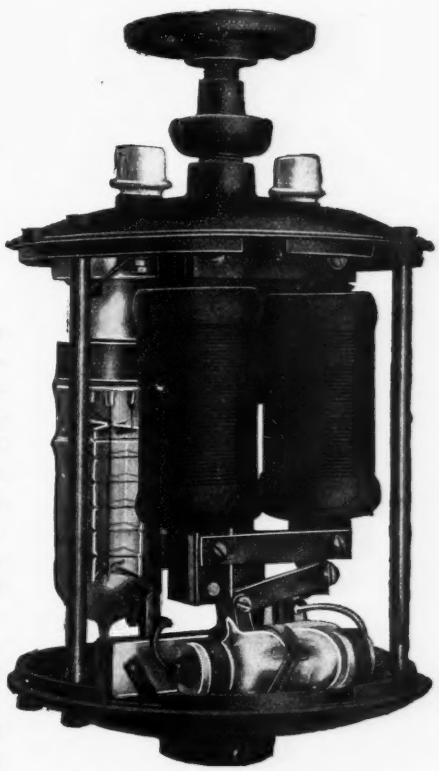


Fig. 1.—Arrangement of Parts of Automatic Starter.

the tube, which is fifty inches long, is entirely stationary and subjected to no motion to effect starting.

This lamp is based on the principle that initial discharge of current can be brought about by applying a relatively high potential across the tube terminals, thus breaking down the starting reluctance and allowing the supply voltage to send cur-

rent through the tube. The high potential is created by interrupting the current through an inductance coil in series with the lamp, by means of a quick-break mercury switch, the so-called "shifter." This is connected in series with a starting resistance across the tube terminals. (See Fig. 2.) When the lamp is switched on the circuit is completed through the inductance coil, the shifter, the starting resistance and the series resistance. The inductance coil, being magnetized by this current, actuates an armature which thereupon causes the shifter to break connection and open the starting circuit. The inductance is thereby caused to create a high potential across the tube terminals, sufficient to break down the starting reluctance of the tube and bring about the lighting.

Fig. 1 shows the arrangement of parts. The shifter is here placed in the foreground at the bottom. It consists of a small glass bulb about two inches long, provided with a V-shaped indentation forming a partial partition and serving to separate the mercury with two puddles forming the electrodes. To each one of these puddles leads a small platinum wire making connections with suitable terminals. The bulb is exhausted to a high degree of vacuum.

When the current is first turned on the shifter is in such a position that the mercury forms a bridge connecting the two leading-in wires together, thus closing the electrical circuit. The shifter is thereupon turned upon its longitudinal axis by the action of the armature, and the partition divides the mass of mercury into two separate puddles, thus breaking the electrical connection.

When the mercury bridge is thus severed the shifter operates for a moment as a small mercury-vapor lamp started on the tilting-lamp principle. However, the amount of current flowing in the shifter is limited by the starting resistance to about one ampere and the shifter therefore continues to run only for a fraction of a second and then goes out. At this instant the initial reluctance of the shifter re-establishes itself, and the current is thereby interrupted with such suddenness that the inductance produces a considerable potential rise (voltage kick).

It is established beyond doubt that the starting reluctance of the tube is chiefly due to an inherent characteristic of the negative electrode. This electrode, of course, always consists of mercury. Not only does this reluctance assert itself when the lamp is being started, but it also tends to re-establish itself at intervals in the running lamp, thereby tending to put the lamp out. The frequency with which this will occur increases with decreasing current. The inductance in series with the lamp tube reacts upon these impulses of the negative electrode with a high-voltage kick which keeps the lamp running continuously at its current, 3.5 amperes. This same inductance, however, maintains the current flow in the shifter for only a fraction of a second, the current in this case being only one ampere.

When the shifter-current is interrupted there takes place a shifting of the current from the shifter to the tube, *i. e.*, the tube starts. Hence the name "shifter." To accomplish this shifting it is, of course, necessary that at the instant of current interruption the (re-established) initial reluctance of the shifter exceed that of the lamp tube. For otherwise the induced voltage kick if sufficiently high would now restart the shifter and not the tube. The fact that the tube does start shows that the (re-established) initial reluctance of the shifter with a separation of electrodes of one-quarter inch exceeds that of the tube with a separation of electrodes of fifty inches, and this strikingly demonstrates that the vapor separating the two electrodes is not the main seat of this reluctance, but that it is located in the electrodes; in this case in the negative electrode.

This distinct quantitative difference between the re-established reluctance of the shifter and initial reluctance of the tube is brought about by an ingenious device applied to the tube which reduces the initial reluctance of the latter to a large extent and thus makes the starting possible. This device is called the "starting band."

The starting band is a metallic coating painted upon the outside of the condensing chamber at the negative electrode of the lamp, and extending above and below the mercury edge formed inside of the chamber. It is connected to the positive terminal of the tube (see Fig. 2) in such a way that it experiences the full rise of potential against the negative electrode

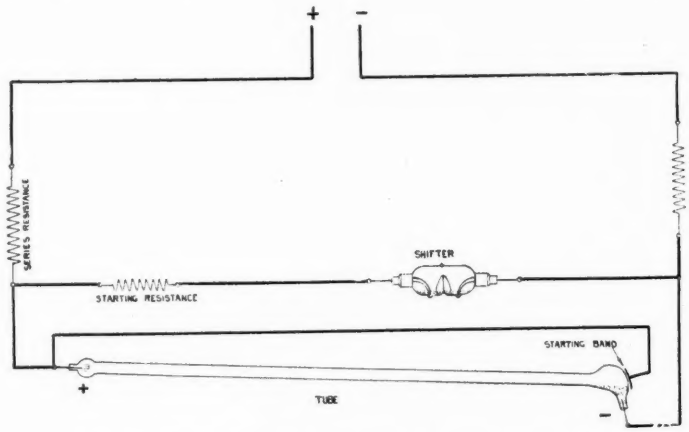


Fig. 2.—Connection of Automatic Mercury-Vapor Lamp.

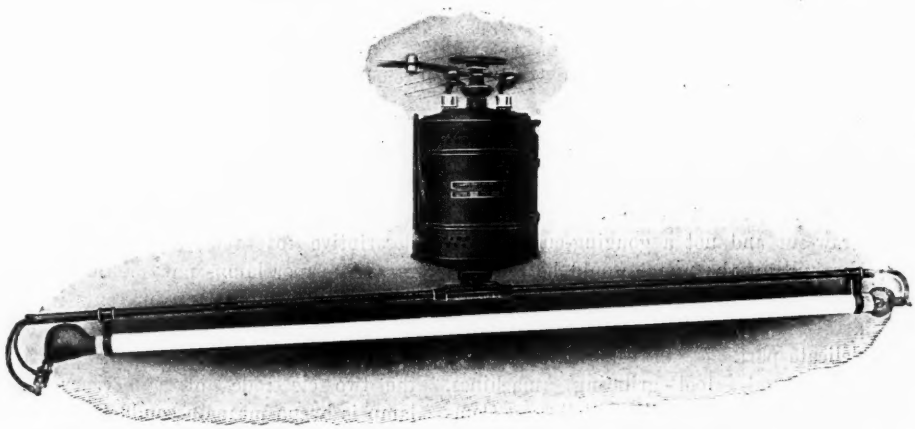
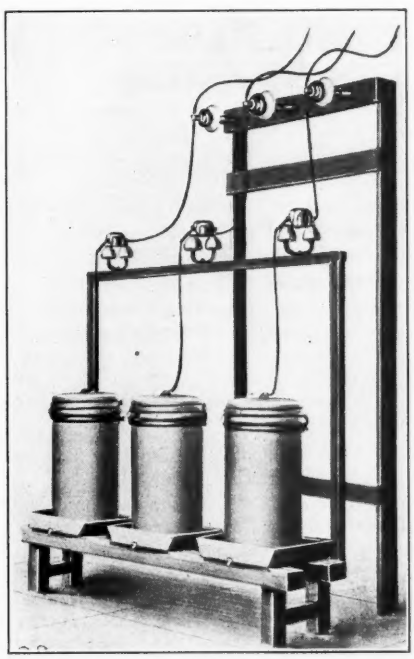


Fig. 3.—New Type, Automatic Starting, Cooper Hewitt Mercury-Vapor Lamp.

during the starting operation. The starting band thus forms one side of a condenser, the other side of which is furnished by the mercury electrode, the glass serving as dielectric. When the high-voltage kick takes place minute sparks may be observed jumping from the mercury surface to the glass inside the bulb. As though these sparks had punctured a highly resisting film upon the mercury surface, the main current now issues from one or several of these punctures. This result is of a similar nature to that produced by the contact-tilting method; the production of conducting vapor and thereby a considerable reduction of the negative electrode starting reluctance.



ELECTROLYTIC LIGHTNING ARRESTER, WITH INDOOR MOUNTING.

The successful application of this method presents a great step forward in the art of mercury-vapor lighting. For while the automatic lighting of mercury-vapor lamps may be brought about by other means, this method—as far as can be judged to-day—approaches the ideal most nearly. For this is the only method by which the tube as a whole as well as every part of it remains perfectly stationary during the lighting process. The tube itself, naturally the most fragile part of the complete lamp, is thereby submitted to the least possible strain during the starting operation, resulting in decreased breakages and consequently increased life. Moreover, the tube remains comparatively simple in construction, is easily handled and readily shipped.

A lamp employing the above method is shown in Fig. 3. The tube is of the familiar form of Cooper Hewitt mercury-vapor lamp, a straight one-inch tube of fifty inches light-giving length. It is provided with the customary condensing chamber on one end and an iron positive electrode at the other end. All the auxiliary apparatus is contained in a compact round housing, from which the tube-holder is suspended.

The lamp yields approximately 800 candle-power, with a power consumption of 3.5 amperes at 110 volts, direct current. Thus an efficiency is obtained of approximately 0.5 watt per candle. The light emitted is highly diffused on account of the great length of tube, while the light source itself is made least offensive to the eyes by a relatively low intrinsic brilliancy. The light is of the familiar greenish blue, characteristic of the mercury spectrum. This lamp is particularly well adapted to all classes of factory work where a large quantity of highly diffused light at a low power consumption is the principal requirement.

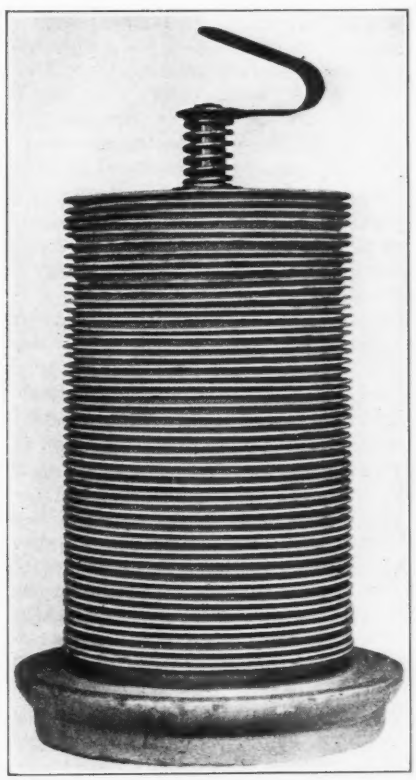
Westinghouse Type E Electrolytic Lightning Arresters.

As the result of experiments covering a number of years, the Westinghouse Electric and Manufacturing Company has developed the electrolytic lightning arrester shown in the accompanying illustrations. It consists of a number of aluminum plates pressed into tray form so that when set one within the other, separated by small insulating washers, they may be built into a column capable of withstanding high voltages and still retain the safety-valve characteristics of a single plate. These columns are made in two sizes, one for voltages between 4,000 and 7,500, the other for voltages between 7,500 and 15,000. The columns are enclosed in substantial stoneware jars. The jars may be mounted one upon the other to form arresters for any desired voltage. A gap on the line side of the electrolytic elements, which will withstand the normal voltage of the system, breaks down with over-voltage and permits the surge to discharge through the electrolytic units.

The electrolyte is dissolved in pure water and poured into the top of the arrester unit. It thus fills the first tray and runs over into the second and so on through the column, the surplus escaping through a hole in the bottom of the containing jar through the next jar, if there be more than one, to the pan at the bottom.

The electrolyte fills only the trays and not the jar, so there is no opportunity for the current to pass except from tray to tray. Each unit when placed in the pan or on another unit automatically makes contact.

The electrolytic solution causes a very thin film to form on the aluminum plates. This film has an apparent resistance of very high value when moderate voltages are impressed upon it, but when the voltage reaches a certain value, it breaks down in myriads of minute punctures, making almost a short circuit. As soon, however, as the voltage is reduced again, the punctures seal up at once and the original high resistance reasserts itself. These arresters are arranged for installation either indoors or out, as suits the convenience of the user.



ELECTROLYTIC LIGHTNING ARRESTER WITH CASE REMOVED.

Westinghouse Machine Company Receivership Vacated.

The receivership for the Westinghouse Machine Company, East Pittsburg, Pa., created last October, was vacated on March 31 by Judge James S. Young, in the United States Circuit Court, on petition of the company and the receivers.

William H. Donner has been elected vice-president of the company, in direct responsible charge of all its facilities.

Current Electrical News

DOMESTIC AND EXPORT.

ELECTRIFICATION OF THE CHICAGO, MILWAUKEE & ST. PAUL—It is announced from Spokane, Wash., that several million dollars will be expended by the Chicago, Milwaukee & St. Paul Railway in developing a large horse-power on the St. Joe River in northern Idaho. Preliminary surveys and plans are now in course of preparation by C. B. Pride, of the company's electrical department.

BELL TELEPHONE COMPANY OF CANADA—W. H. Cushing, minister of public works for Alberta, has completed arrangements with the Bell Telephone Company of Canada for the purchase of its lines in Alberta for $675,000. The Bell company a short time ago sold out its lines in Manitoba to the Manitoba Government, and the only lines it now has west of the Great Lakes are those in Saskatchewan and in the cities of Port Arthur and Fort William.

AUTOMATIC COMPANY FILES MORTGAGE—The new Automatic Electric Company has filed a mortgage for $1,000,000 to secure an issue of a similar amount of twenty-year six per cent gold bonds which will be exchanged for the $5,000,000 capital stock of the Strowger company in the ratio of $20 in bonds for each share, par value $100, of the latter corporation's capitalization. The bonds are a first mortgage on the consolidated property. They will be issued in denominations of $100, $500 and $1,000, and the First Trust and Savings Bank of Chicago has been named as trustee under the mortgage.

DENVER CAPITALISTS PLAN EXTENSIVE IMPROVEMENTS TO PLANT IN NEVADA—The Nevada-California Power Company, which is owned by Denver, Col., capitalists, is preparing to spend $500,000 this summer in enlarging and extending its plants in Nevada. The company owns the system of power plants which supplies power and lights to the Goldfield and surrounding districts. The company is offering $500,000 first mortgage six per cent sinking fund bonds. The bonds are dated April 1, 1907. The company has a 7,500-horse-power plant near Goldfield which is to be enlarged to double that capacity and the proceeds from the sale of the bonds will be for that purpose. The company now has $2,319,000 outstanding in bonds.

EXTENSIVE INTERURBAN SYSTEM FOR TEXAS—Boston capital is back of a project to build a series of electric railways in east Texas aggregating about 400 miles of road, which will eventually connect 1,200 miles of electric railways in Texas extending from Dallas to Houston, with branches extending east and west to Waco, Marlin, Crocket, Athens, Huntsville and a score of smaller towns. H. L. Norton is representing the eastern syndicate. The first fifty miles of the project have been decided upon. The line will connect the towns of Jacksonville, Rusk, Morrill, Alto and Crockett. Contracts for construction aggregating $750,000 will be awarded. The new electric road will handle freight and penetrate a rich fruit and truck-growing section. The whole project represents a $10,000,000 proposition.

ROCHESTER-CORNING-ELMIRA ROAD AUTHORIZED BY PUBLIC SERVICE COMMISSION—The Rochester-Corning-Elmira Traction Company, which proposes to build a double-track electric road from Rochester to Elmira, N. Y., a distance of 120 miles, has been authorized by the Public Service Commission to issue capital stock to the amount of $3,880,000, being the full amount of its authorized capital stock now unissued, making a total of $5,000,000 stock, and its thirty-year five per cent gold bonds to the amount of $4,210,000, and the execution and delivery of a mortgage upon all its property, assets and franchises to the maximum amount of $6,000,000 to secure the payment of said bonds and such other bonds as may be issued pursuant to the authorization of the commission. The company applied for permission to issue a first mortgage for $8,000,000 and $8,000,000 bonds under the mortgage. The total capitalization now allowed is $9,210,000 instead of $12,000,000 applied for. The order provides that the proceeds of stock and bonds shall be used for the acquisition of property in the construction of the proposed double-track road from Rochester to Elmira and for the construction and completion of the road and the maintenance of its service thereon in accordance with the plans submitted. The authorization was made upon the express conditions that stock may be issued without the further permit or authorization of the commission, but for not less than the par value thereof. No bonds shall be issued or sold at less than eighty-five per cent of the face or par value thereof. No bonds shall be issued or sold without the further authorization of the commission upon sworn report of the terms of sale nor until the capital stock is fully subscribed by responsible parties.

NEW MANUFACTURING COMPANIES.

SPRINGFIELD, ILL.—The Western Conduit and Manufacturing Company has been incorporated to manufacture and deal in electrical apparatus. The capital is $50,000, and the incorporators are: William Campbell, A. S. Rhyniger and George F. Mulligan.

ROCHESTER, N. Y.—Haverstick & Company have been incorporated to manufacture steam, water, electrical, gas and mill supplies and specialties. The capital is $50,000, and the incorporators are: F. Haverstick, H. E. Cory and H. D. Shedd, Rochester.

ALEXANDRIA, VA.—The state corporation commission has granted a charter to the Pettey Electrical Signal Company, of Alexandria. The capital stock is placed at $10,000, and the objects are to conduct an electrical supply business. The officers, all of whom are of this city, are: F. M. Hill, president; Zora Hill, secretary and treasurer; George W. Pettey, manager.

BIRMINGHAM, ALA.—The Southern Illuminating Company, capitalized at $15,000, and with its stock fully subscribed, has asked for a charter. The company proposes to manufacture and handle various electrical and other appliances, and particularly to act as agent for the Just tungsten lamp. The officers and incorporators are: Noah T. Thomas, president; L. P. Spivy, vice-president; J. S. Brown, secretary; Roscoe McConnell, treasurer. The company's offices will be in Birmingham.

NEW PUBLICATIONS.

AMERICAN CIVIC ASSOCIATION—The American Civic Association has prepared a clipping sheet arranged and edited by Henry A. Barker, chairman of the special committee on national forests and department of parks and public reservations, in the interest of the national forests in the East. The American Civic Association is working for national ownership of the eastern mountain forests.

LIGHTING RATES IN OHIO—The Ohio Electric Light Association has published a bulletin entitled "Lighting Rates in Ohio," the data having been collected and compiled by D. L. Gaskill, of Greenville, Ohio, secretary of the association. This bulletin includes the name of the company, location and population, contract with the municipality, character of service, and rates for commercial lighting.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS—Volume xii of the proceedings of the twelfth annual convention of the International Association of Municipal Electricians for the year 1907 has been issued. This gives a report of the convention held at Norfolk, Va., August 7, 8 and 9 of last year. It contains the following papers: "The Operation of a Municipal Lighting Plant in Connecticut," by A. L. Pierce; "The Luminometer Methods of Inspecting Street Arc Lamps," by C. S. Downs; "Specifications for Electric Lighting, Altoona, Pa.," by C. S. Downs; "Municipal Electric Inspection and Records," by R. A. Smith, and "Modern Applications of Storage Batteries," by W. M. Petty. There are also a short but interesting question box, and the reports of the various association committees.

ELECTRIC LIGHTING.

LACONIA, N. H.—The Laconia Electric Lighting Company has increased its capital stock from $50,000 to $100,000.

PLACERVILLE, CAL.—The board of trustees has decided to investigate the feasibility of a municipal electric light plant.

WOODLAND, CAL.—E. Lehe has been granted franchises to furnish electric lighting for the town of Davis and the State Farm.

HENNIKER, N. H.—The town has decided to renew its contract with the Hillsborough Electric Light and Power Company for street lighting.

COLUMBIA, MISS.—The plant of the Columbia Ice and Power Company is expected to be in operation by May 1. The manager is Lee Elder, formerly of Biloxi.

SOUTH BEND, WASH.—The South Bend-Raymond Electric Company's line has been extended to South Bend. Five arc lights have been put on the village streets.

DANVILLE, ARK.—The city council has granted A. Pace a franchise to install an electric light and fan system at this place, Mr. Pace has the power-house erected.

DAVENPORT, IOWA—An agreement has been reached whereby the Independent Light and Power Company has sold its plant in Davenport to the People's Light Company.

STROMSBURG, NEB.—F. E. Halden, the manager of the Stromsburg Electric Light, Heat and Power Company, has sold his interest in the plant to Elmer Jeffreys, of Benedict.

GENEVA, N. Y.—The Geneva-Seneca Electric Company contemplates some changes and improvements to its plant, and has engaged an engineer to report upon the matter.

PATERSON, N. J.—The Public Service Corporation has consented to reduce the price of county arc lights from $140 a year to $100 a year. The present contract has three years to run.

CHICAGO, ILL.—The North Shore Electric Company will issue $530,000 new stock at par; each stockholder paying in full by May 1 receives twenty per cent of his holdings in treasury stock as a bonus.

MARQUETTE, MICH.—Marquette's municipal electric light plant shows a net profit for the year just closed of $30,500. There were retired during the year $21,500 in bonds, of which only $2,500 had matured.

ORION, ILL.—The municipal electric light plant was destroyed by fire on March 26, involving a loss of $8,000, with no insurance. It is thought that the plant will be rebuilt, if not by the village, by a private company.

PATERSON, N. J.—A private electric light and power plant is being planned with Captain Charles Curie at the head. It is contemplated to supply the entire block in which the Colt Building, owned by Mr. Curie, is located.

JERSEY, CITY, N. J.—The Mutual Light and Power Company, which seeks to furnish light for the city, and asks for a twenty-year franchise to lay wires under the streets, has made a formal application for a franchise to the board of aldermen.

WAKEFIELD, MASS.—The town has appointed a committee of nine to consider the advisability of abolishing the municipal lighting plant. The matter came to a head when the light commissioners asked for an additional appropriation of $72,000 to rebuild the plant.

MANSFIELD, LA.—At a special meeting of the city council the sale of the electric light plant, which has been owned and operated by the town for the past several years, was authorized. It is probable that a local stock company will be organized to operate the plant.

ALBANY, N. Y.—The Public Service Commission has granted authority to the Keyes Electric Company, of Gowanda, to issue $44,000 common capital stock, a mortgage for $8,000 and consent to transfer rights and franchises of the Consolidated Electric Light and Power Company to the Keyes Electric Company.

BOISE, IDA.—Work will be started at once on the proposed power plant of the Twin Falls Power Company on the Snake River at Salmon Falls near Hagerman, about ten miles southwest of Wendell. The plant will cost between $400,000 and $500,000 and will generate 30,000 horse-power. A. J. Wiley is consulting engineer.

BRIDGEPORT, TENN.—A ten-year franchise has been granted to C. A. Sutliff and associates, of South Pittsburg, Tenn., for operating an electric light and power system; also the construction of a street railway system. It is the intention of this company to construct an interurban system to connect the towns of Bridgeport, Copenhagen, Richards City, South Pittsburg and Jasper, Tenn.

JACKSON, KY.—The Jackson Electric Light and Power Company has been reorganized under the name of the Jackson Electric and Hydraulic Manufacturing Company, with L. P. Gunn, A. S. Moore and J. W. Norwood, of Lexington, as incorporators. The new concern will operate a light plant and waterworks and will manufacture ice. The company is now incorporated for $20,000.

BIEBER, CAL.—A project of considerable importance to Fall River Valley is being considered. This is to divert about 6,000 inches of water from Fall River at Manning Falls and convey it by means of a tunnel through Saddle Mountain to Pit River for the purpose of generating electricity. The cost of the undertaking will be something over $100,000 and work on the project is scheduled to commence this spring.

STAUNTON, VA.—A deal has been completed whereby J. M. Spotts becomes practically the sole owner and controller of the Blue Ridge Light and Power Company, which includes the street-car plant and the mercantile electric lighting plant. Mr. Spotts bought the interest of John H. and C. P. Bowman, W. C. Bosserman, J. R. Kemper, Andrew Bolling and A. M. Valz. He will probably make extensive improvements in the street-car service.

GENEVA, N. Y.—The Economic Power and Construction Company has signed the contract with the city whereby that company rents two ducts in the city conduit system for a term of twenty years at an annual rental of five cents per duct foot. The contract calls for 5,515 feet starting April 1 and as many more as the company may from time to time need. Furthermore the company agrees to enter any conduits which may in the future be constructed by the city.

COLUMBUS, OHIO—Papers have been filed with the secretary of state increasing the capital stock of the Columbus Edison Company from $1,000,000 to $1,500,000. The additional half million represents an increase of the common stock of the company from $450,000 to $750,000, and of the preferred stock from $550,000 to $750,000, the new stock to be issued in $100 shares. The increase in the capital stock was authorized some time ago by the stockholders of the company.

NIAGARA FALLS, ONTARIO—The report of the auditors of Thorold on the operation of the municipal electric lighting plant shows that after paying all expenses and operating twenty-five arc lights, there is a cash surplus of $795.05. After taking over the lighting plant some years ago the town council reduced the price of light to four cents a week per sixteen-candle-power lamp. The town is now completing a new waterworks plant to cost $90,000. It will be operated in connection with the lighting plant.

NORTH YAKIMA, WASH.—Mayor Henry H. Lombard has been elected president of the Yakima Intervalley Electric Railway Company, which proposes to build a line from this city to Granger. Captain J. H. Thomas was elected vice-president; R. G. Page, of Sunnyside, treasurer, and George P. Eaton, of Granger, secretary. At a meeting of the company in this city these officers were elected and the report of T. A. Noble, the engineer, was read. The report was accepted. Steps will be taken to secure right of way, but no date is set when construction work will begin.

BOLIVAR, OHIO—Canton men have formed the Bolivar Electric Company, capitalized at $30,000, to build an electric lighting plant at Bolivar. It will be operated by water power from the Tuscarawas River. A twenty-five-year franchise has been granted the company. The president is L. P. Conrad, of Canton; secretary, A. H. Elliot, of Canton; treasurer, R. P. Lambright, of Canton. These officers, with H. C. Long and W. S. Allen, both of Canton, form the directorate. The capital stock is $15,000 in common and $15,000 in seven per cent preferred. A contract has been made with the town of Bolivar to supply twenty arc lights for street illumination.

ELECTRIC RAILWAYS.

ALTON, ILL.—C. F. Stelzel, of Granite City, will apply shortly to the Alton city council for a street-railway franchise.

MEXICO, MO.—An $850,000 mortgage has been filed for the building of the electric line from Perry, Ralls County, to Mexico.

PERRY, N. Y.—The Rochester, Scottsville & Caledonia Electric Railroad Company has been granted a franchise by the village board of trustees.

BOISE, IDA.—A contract has been let to the Donald Grant Company for the construction of the Gooding-Milner electric railroad. The road will be sixty miles in length.

HARTFORD, CT.—Steps are being taken for the forming of a company to build a trolley line from Meriden to this city. The charter for the line was obtained four years ago.

DAYTON, OHIO—The Dayton Street Railway Company will immediately begin construction work. Fourteen miles of track will be laid. The line is to touch points in northwest and southeast Dayton.

CINCINNATI, OHIO—The Cincinnati Traction Company is about to install a substation in its Brighton barns, at Harrison and Cable avenues, which will cost about $100,000, contracts for which have been let.

BELLEFONTAINE, OHIO—The city council has granted a twenty-five-year franchise to the Schoepf syndicate. In return the company will pay a paving assessment of $4,300 and operate a city car service.

FLINT, MICH.—The Detroit, Flint & Saginaw electric road has been ordered by Judge Wisner to be sold to satisfy a balance of $479,775 due on a mortgage for $1,000,000 held by the Detroit Trust Company.

TOLEDO, OHIO—A receiver has been appointed for the Toledo & Indiana Electric Railway Company. The road, which extends from Toledo to Bryan, a distance of fifty miles, defaulted on the interest on its bonds.

SALINA, KAN.—The Commercial Club of Salina has taken up the proposition of building an interurban railway, with a system of lines extending in different directions from that city. It is proposed to form a company capitalized at $100,000.

RACINE, WIS.—It is announced that the extension of the Chicago & Milwaukee Electric Railway between this city and Milwaukee will be abandoned for this year because of the inability to secure sufficient money to push the line to completion.

NORWICH, CT.—The Norwich & Westerly Railway has completed a deal whereby it takes over the Pawcatuck Valley Street Railway Company in Westerly and running to Watch Hill. The Norwich & Westerly road will run its line to Pleasant View and Weekapaug.

GREELEY, COL.—The Denver & Greeley Electric Railway Company, composed of Denver and Greeley business men, has been granted a franchise by the city council, allowing it to enter this city under certain restrictions, provided the road is completed in three years.

SONGO LOCK, ME.—It is learned that work on the Portland & Northern Railroad, to run from Portland to Bridgton, through Morrill's Corner, Pride's Corner, Highland Lake, North Windham, Raymond, Casco, Naples and Bridgton, will be commenced within a few months.

ST. LOUIS, MO.—The council bill extending the time one year for the starting of cars on the lines of the St. Louis Electrical Terminal Railway (McKinley system) has been passed by that body. The company wants to finish its bridge before starting cars on this side of the river.

COLUMBUS GROVE, OHIO—In accordance with the plans of beginning work on uncompleted portions of the line, the Ohio Electric Railway Company is hastening to completion the building at Leipsic, wherein will be installed a substation and depot. The new structure will cost $10,000.

GREENSBURG, PA.—A company has been formed to build a street-car line from Manor to Claridge and a survey of the proposed route is now being made. The officers chosen are as follows: President, H. A. Lauffer; vice-president, William J. Kemerer; secretary, John Naley; treasurer, F. R. Rankin.

EXETER, N. H.—The two companies into which the Exeter, Hampton & Amesbury Street Railway has been reorganized have filed articles of incorporation under the state law with the secretary of state. They are the Exeter Railway and Lighting Company, capital stock, $340,000, and the Exeter & Hampton Electric Company, capital, $100,000.

STOCKTON, CAL.—The first decided step to construct a road through the rich Manteca, French Camp and Ripon district to the south and east of Stockton has been taken in the incorporation of the San Joaquin Investment Company with a board of directors composed of prominent ranchers or property owners in the various localities through which the road will pass.

GREELEY, COL.—E. N. Reaser, of Denver, president of the Interurban Construction Company states that within a few weeks a large force will start work for his company, and will first build from Idaho Springs Junction to Fort Lupton and thence to Greeley and Denver. This company has a twelve-foot right of way on the county road between Denver and Greeley, paralleling the Union Pacific.

SAN ANTONIO, TEX.—Interurban development in southwest Texas is about to begin by the building of an electric railway through the truck gardens south of this city to the Terrell Hot Wells. From there it will later probably be extended to the old French town of Castroville. The Terrell Hot Wells were lately purchased, with 2,000 acres adjoining, by a syndicate of New York capitalists, of which N. R. Bagley is the head.

WATERLOO, IOWA—The lines of the Waterloo, Cedar Falls & Northern Railway will be extended this season to Westfield and other outlying districts of the city, connecting them with the business district and completing a loop between the west side loop and the Cedar Falls line on the north. The improvements are to cost about $75,000. The Chamber of Commerce is responsible for the extensions, and has agreed to provide a five-year loan of $30,000 for the company.

ANNAPOLIS, MD.—A bill, the purpose of which is to allow the Baltimore & Annapolis Short Line to enter the city as an electric line, has been introduced in the House. The bill provides for the incorporation of the Short Line Terminal Company, with capital up to $1,500,000, and is for the purpose of having the Annapolis line enter the city, with a franchise from the Baltimore city council, either by surface, inclined or underground means. A connection with the United will be made at some convenient point.

KANSAS CITY, MO.—The Missouri & Kansas Interurban Railway, known as the Strang line, in operation between Kansas City and Olathe, and projected to Topeka, has been sold to the interests controlling the Kansas City-Western Railway Company, owning and operating the trolley line between Kansas City and Fort Leavenworth, and in the city of Leavenworth. The Strang line is to be completed to Topeka and probably southward to link with the interurban system now in operation in southeastern Kansas and southwest Missouri.

NEWCASTLE, IND.—It is stated that an agreement has been reached between the creditors' committee of the Indianapolis, Newcastle & Toledo Electric Railway Company and the promoters of the line whereby receivers' certificates shall be issued sufficient to complete the road. It is estimated that $400,000 is necessary to do this. It is expected that the line will be put into operation between this city and Indianapolis this summer. Thirty miles of track are built, and the power-house is complete, with the exception of the installation of the machinery.

FREDERICK, MD.—A survey has been made for a new trolley road from Myersville to Wolfville, a distance of six miles. The new line will pass through the northern end of the Middletown valley and is to be a feeder for a rich section of country to the Myersville & Hagerstown and Frederick interurban lines, which converge at Myersville, halfway between Frederick and Hagerstown. Rights of way along the new line have been donated and about two-thirds of the cost of building the road has been subscribed.

The land contiguous to the road is the best in the county for peach growing.

JEFFERSON, IOWA—The stockholders of the Jefferson Interurban Railway Company have completed their organization and their articles of incorporation have been adopted. Officers have been elected as follows: Albert Head, president; Henry Haag, vice-president; Mahlon Head, treasurer. Directors: Henry Haag, Albert Head, P. L. Cockerill, E. H. Carter, S. J. Sayers, Judge Z. A. Church, J. M. Forbes, A. D. Howard and Fred E. Gamble. The company commences business with a capital of $10,000, and the preliminary work of securing a right of way will be instituted at once.

HANOVER, PA.—It is stated that the Hanover & McSherrystown Street Railway Company will be extended from Hanover to Littlestown. A project is also in contemplation to extend the lines from McSherrystown to New Oxford, Berlin Junction, Abbottstown and East Berlin. The plans of the local company also call for the extension of the Frederick street line to Pennville, and probably to Mount Pleasant, two miles south of Hanover. John Dobbling, of York, has secured the contract to complete the construction of the road within ninety days on the Littlestown extension.

BROWNSVILLE, TEX.—The St. Louis syndicate which recently purchased the Matamoros & Santa Cruz street railway is going ahead with preparations to reconstruct and convert the road into an electric line as soon as possible, also to extend it and connect with the National Lines. The new company absorbed the Rio Grande Railroad, operating about twenty-two miles of line between Brownsville and Point Isabelle, Tex., and it is proposed to convert this into an electric railroad also. The syndicate which has the work in charge is composed of E. Scott, R. Brookings, W. H. Bixby, T. West, S. Fordyce, H. Hartick and others.

PASADENA, CAL.—A new corporation, being a consolidation of the San Francisco, Oakland & San José Railway, known as the "Key Route," and the San Francisco & Bay Counties Railway, recently incorporated for the construction of an electric line to San José, has been formed with a capital stock of $7,750,000. F. M. Smith and associates are the incorporators. Among other objects is the connection of the Oakland mainland with the Yerba Buena or Goat Island by tunnel, tube or subway. Application is to be made to the United States Government and the state of California for permission to construct the subway or tunnel.

SMYRNA, DEL.—The National Construction Company, incorporated at Dover, will build a trolley road from Delaware City to Lewes, passing through Smyrna, Dover and Milford. The company will have its principal offices here. J. W. Endean, who is the chief engineer and general manager of the Smyrna, Kent County & Delaware Bay Traction Company, is the chief engineer and general manager of the new company. John D. Thompson, a Wilmington architect, has been commissioned to prepare plans and specifications for a power station to be erected at St. Georges, and as soon as these are completed tenders will be called for and the work taken in hand.

ANNAPOLIS, MD.—A bill has been introduced in the House to incorporate the Rural Electric Railway and Power Company. The incorporators named in the bill are: Hugh J. Gallagher, Walter A. Gephart, W. T. Dietrick, Dr. Harry C. Hess, Robert W. Mobray and Jacob S. Parr. The route of the proposed road is from Lauraville to the Falls road, and from Baltimore city to Sparrows Point, by way of North Point road. Extensions of the proposed road are provided for. The capital stock is $500,000, with power to increase, in the discretion of the directors. The company is authorized to construct and operate branch roads and to connect with other roads and with steamboats. The power of consolidation is given.

EDUCATIONAL NOTE.

POLYTECHNIC INSTITUTE OF BROOKLYN—The catalogue of the College of Engineering of the Polytechnic Institute, of Brooklyn, for 1908-1909, has been issued. This gives a synopsis of the regular courses offered by the various departments and the extension courses offered during the evening. The intention of these is to enable men who are employed during the daytime to carry on college work. The registration shows that the institute has 557 regular students and 258 students in the extension courses, making a total of 815.

ELECTRICAL SECURITIES.

While there has been a continuance of the slackening tendency indicated last week there has been no abandonment of the idea that business is showing a general improvement. Continued reports of economies in all lines come from all quarters, and the most hopeful viewpoint of this situation is that under these circumstances, although progress will be slow it will be honest and healthy, and will form a substantial basis for more vigorous development later on.

Dividends have been declared upon the following electrical securities: Nebraska Telephone Company; regular quarterly dividend of $1.50 per share, payable April 10. Columbus (Ohio) Railway and Light Company; regular quarterly dividend of one-half of 1 per cent on the common stock, payable April 15. National Light, Heat and Power Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 1. Duluth (Minn.) Edison Electric Company; regular quarterly dividend of 1½ per cent on the preferred stock. Brooklyn (N. Y.) City Railroad Company; quarterly dividend of 2½ per cent, guaranteed by the Brooklyn Rapid Transit Company, payable April 15. Milwaukee (Wis.) Electric Railway and Light Company; regular quarterly dividends of 1½ per cent on the preferred and 1½ per cent on the common stocks, payable April 30 to stock of record April 20. North Shore Electric Company, Chicago; initial dividend of three-quarters of 1 per cent, payable May 1.

ELECTRICAL SECURITIES FOR THE WEEK ENDED APRIL 4.

New York:	*Closing.*
Allis-Chalmers common	7⅜
Allis-Chalmers preferred	18½
Brooklyn Rapid Transit	45¼
Consolidated Gas	118
General Electric	125
Interborough-Metropolitan common	7
Interborough-Metropolitan preferred	18½
Kings County Electric	103
Mackay Companies (Postal Telegraph and Cables) common	57
Mackay Companies (Postal Telegraph and Cables) preferred	62
Manhattan Elevated	118
Metropolitan Street Railway	17
New York & New Jersey Telephone	100
Western Union	51
Westinghouse Manufacturing Company	55

Boston:	*Closing.*
American Telephone and Telegraph	109¼
Edison Electric Illuminating	206
Massachusetts Electric	45
New England Telephone	—
Western Telephone and Telegraph preferred	62½

At the annual meeting of the American Telephone and Telegraph Company Harry H. Brigham and Charles L. Green were elected directors, succeeding Frederick P. Fish and Charles E. Perkins. Other directors were re-elected. The directors of the American Telephone and Telegraph have elected B. E. Sunny vice-president to take the place of Thomas Sherwin. Other officers were re-elected.

Philadelphia:	*Closing.*
Electric Company of America	9
Electric Storage Battery common	27
Electric Storage Battery preferred	27
Philadelphia Electric	7½
Philadelphia Rapid Transit	16¾
United Gas Improvement	77¼

Chicago:	*Closing.*
Chicago Telephone	114¾
Commonwealth Edison	91
Metropolitan Elevated preferred	49
National Carbon common	59
National Carbon preferred	110

Metropolitan Elevated's daily traffic average for March was 145,660 passengers, a decrease of 9,130; the Northwestern Elevated's daily average of passengers was 103,130, an increase of 13,786. South Side Elevated's daily traffic average was 114,891 passengers, a decrease of 14,665. The Chicago & Oak Park Elevated's daily March passenger average, including transfers was 46,489, a decrease of 2,524.

During March the Chicago Telephone Company gained 3,564 telephones. The total now in use is 211,944.

PERSONAL MENTION.

MR. FRED BISSELL, president of the F. Bissell Company, Toledo, Ohio, was a Chicago visitor last week.

MR. H. C. OSBORNE, of Toronto, Ontario, has been elected vice-president of the Chicago & Milwaukee Electric Railroad. President A. C. Frost and Secretary Pierre G. Beach succeed themselves.

MR. VAN RENSSELAER LANSINGH, manager of the Holophane Company, addressed the Chamber of Commerce, Utica, N. Y., on "Modern Illumination," on the evening of Tuesday, March 31.

MR. FRED C. TIMPSON, formerly general manager of the Empire State Telephone and Telegraph Company, has been appointed chief of the Bureau of Insular Telegraphs and Telephones, Porto Rico. Mr. Timpson has under his direction over 250 men, and is making fine progress in developing this system.

MR. JAMES W. JOHNSON will become manager of the Chicago office of the General Electric Company, succeeding B. E. Sunny, who has been elected a vice-president of the American Telephone and Telegraph Company. Mr. Johnson has, for several years, been assistant manager of the Chicago office, and is, therefore, thoroughly qualified to assume his new duties.

MR. F. K. POTTER, for a number of years connected with the Capell Fan Engineering Company, has been appointed manager of the Pittsburg district for the Sirocco Engineering Company, with headquarters in the Keenan Building, Pittsburg, Pa. It is only recently that the Sirocco Engineering Company has begun the manufacture of Sirocco fans and blowers at its new plant at Troy, N. Y.

MR. FRANK MACGOVERN announces that he has associated himself with J. Warren Archer, and organized the new firm of MacGovern, Archer & Company. The company will deal in electrical and steam machinery, cars, car equipment, railway motors and controllers, and act as machinery experts and appraisers. Mr. MacGovern was formerly vice-president and general manager of Rossiter, MacGovern & Company, and Mr. Archer was manager of the sales department of that concern.

MR. H. B. RAMEY has been appointed sales manager of the motor department of the Robbins & Myers Company, Springfield, Ohio. Mr. Ramey is well known throughout the electrical field, and has been prominently identified with a number of large corporations in the Central States. In 1901 he became connected with the Warren Electric and Specialty Company, representing at the same time the Peerless Electric Company, of Warren, Ohio. He was later secretary and manager of the Monarch Electric Manufacturing Company, and subsequently sales manager of the Economy Electrical Company, of Warren. After this engagement he was special representative of the Sterling Electric Manufacturing Company, of Warren, which position he resigned on April 1 to accept his present post. Mr. Ramey has a great many strong friends in the trade, and will be a tower of strength to the sales organization of the Robbins & Myers Company.

MR. G. C. PIERCE, for the past two years superintendent of the St. Louis & Suburban Railway properties, has tendered his resignation and will leave East St. Louis shortly to take up civil engineering. Mr. Pierce will make a visit to California with his family, after which he will return East. Mr. Pierce is possessed of great ability as an engineer and operating man, and has applied himself so closely to his duties as general superintendent that a breakdown in health was feared. He has made a great many friends in East St. Louis, and they will greatly regret the departure of himself and his family. Mr. C. F. Hewitt, general superintendent of the St. Joseph Railway, Light, Heat and Power Company, of St. Joseph, Mo., another Clark property, will succeed Mr. Pierce. Mr. Hewitt has been identified with the Clark properties in the operating department for several years, and is a man of wide experience in the operation of railway and lighting properties.

MR. B. E. SUNNY, vice-president of the General Electric Company, with headquarters in Chicago, Ill., has been elected vice-president of the American Telephone and Telegraph Company. Mr. Sunny is an old telephone man with many years' practical experience in this industry. He began his telegraph career with the Atlantic & Pacific Telegraph Company, with which he was associated from 1872 to 1875. He went to Chicago as operator for that company, and soon afterwards was made night manager and later manager of the Chicago office. He left the telegraph business in 1879 to become superintendent of the Bell Telephone Company, and later of the Chicago Telephone Company, representing the combined Bell and Edison companies. He remained in the telephone service nine years, and was closely identified with the first successful efforts to operate telephone wires under ground. He became president of the Chicago Arc Light and Power Company in 1888. He next became assistant manager of the Thomson-Houston Electric Company in 1890. As vice-president of the General Electric Company, in charge of western operations, Mr. Sunny continued his great executive work, and has made this one of the strongest offices of that corporation. He is one of the best-known men in the electrical field to-day, and his election to this prominent office with the American Telephone and Telegraph Company indicates that this company contemplates a great expansion of its properties throughout the western part of the country and much closer executive management of the territory between Chicago and the Pacific Coast.

TELEPHONE AND TELEGRAPH.

HOUSTON, TEX.—The Western Union Telegraph Company proposes to do about six months' work in rebuilding its lines in the city of Houston.

SALT LAKE CITY, UTAH—Elmer B. Jones, managing director of the Utah Independent Telephone Company, has resigned, turning over the management of the company to a new board of directors selected by H. A. Harvey, who will represent George A. Berger, of the Trust Company of New Jersey, owner of the capital stock of the telephone company.

BUTTE, MONT.—H. L. Burdick, superintendent of construction of the Rocky Mountain Bell Telephone Company, says the lines of the company in Montana will be extended eastward during the present year, connecting with the North Dakota exchange and establishing telephone connection between Minneapolis and Butte and Pacific Coast points.

READING, PA.—The Bell Telephone Company has completed the installation of a new rural line. It starts from the Reading exchange and covers a section of the county never touched by the telephone. Its subscribers are located along and near what is known as the Dry road, in Spring township, and in North and Lower Heidelberg townships.

CHEHALIS, WASH.—Eugene A. Marsh, representing the Seattle Electric Company, the Portland Electric Company and the Northwestern Long-Distance Telephone Company has applied to the city council for a franchise for the construction of an electric railroad, light and power plant, and a telephone and telegraph system in Chehalis and Centralia.

TROY, N. Y.—There have been filed in the county clerk's office articles of incorporation of the Pittstown Telephone Company. The directors are: Elmer E. Hayner, Paul H. Sherman, E. Everett Welling, Irving Brownell, Stewart W. Humphrey, Elihu L. Button and William B. Sherman. Mr. Hayner is president and Mr. Welling is secretary. The corporation is a part of the Bell system.

HARTFORD, CT.—The certificate of organization of the Connecticut Home Telephone Company has been filed in the office of the state secretary. The capital stock is $30,900 of which $7,250 has been paid in. The officers of the corporation are: President, Lewis Sperry; vice-president, Frank H. Wheeler; treasurer, J. H. Hale; secretary, H. P. Freeman, Jr.; assistant secretary, Robert P. Lyon. The principal office of the corporation is located at Hartford.

ELIZABETH, N. J.—A certificate of incorporation for the McLutz-Lockwood Manufacturing Company has been filed with the county clerk. The object of the corporation is to manufacture and deal in electric batteries, generators, etc. The principal office in New Jersey is situated on Westfield avenue, Aldene, Roselle. The authorized capital stock is $100,000, consisting of 1,000 shares of the par value of $100 each. The incorporators are: Richard M. Barwise, Whittemore Dodd and Charles D. Low.

PLATTSBURG, N. Y.—At a meeting of the Clinton Telephone Company, held in this city, it was stated that construction work on new lines will be resumed in the early spring. It is expected that the through line to Albany and intermediate points will be completed early in the summer and that the lines in the vicinity of Dannemora will also be extended. The company is in a prosperous condition, every quarter since the opening of business in this city showing a gain over the previous quarter. The company now has an actual service in Plattsburg of over 1,100 telephones, and this number is being added to almost daily.

NEW INCORPORATIONS.

HARRISBURG, PA.—Fombelle Telephone Company, Fombelle, Beaver County. $5,000. Treasurer, J. F. Schram, Fombelle.

COLUMBUS, OHIO—Avon-Sheffield Telephone Company, Avon; $10,000. Grafton Mutual Telephone Company, Grafton; $10,000.

TOWER CITY, PA.—Sterling Electric Light, Heat and Power Company, Tower City. $22,000. Treasurer, John Peiffer, Tower City.

PORTLAND, ME.—Crawfordsville Water and Gas Company, Portland. $375,000. President, H. L. Cram; treasurer, B. L. Steward, Portland.

CHICAGO, ILL.—Chicago, Joliet & Central Illinois Railway Company. $2,500. To build a road in the counties of Cook, Will, DeKalb, Grundy, La Salle, Bureau, Putnam, Marshall, Peoria, Woodford, Livingston and McLean.

HARRISBURG, PA.—The Elizabethtown & Florin Street Railway Company; increase in capital stock from $30,000 to $220,000. Donore & Eldora Street Railway, in Washington County; increase in stock from $24,000 to $150,000.

CINCINNATI, OHIO—Paint Creek Power, Light and Heat Company, of Cincinnati. $10,000. Incorporators: Leonard W. Goss, Charles J. Hasbrook, D. S. Hasbrook, William D. Alexander and Wilbur Schmidt, Jr. To build power dams across Paint Creek, in Ross, Highland and Fayette counties.

GUTHRIE, OKLA.—The Cherokee Belt & Interurban Railway Company, Tulsa. $500,000. To build a line connecting Tulsa, Collinsville and other towns in the northeastern part of the state. Incorporators: F. E. Montee, of Kansas City, Mo.; S. W. Butterworth, of Tulsa; J. R. Soudle, E. Pleas and A. E. Leap, of Collinsville.

OAKLAND, CAL.—Suburban Light and Power Company. $1,000,000. To furnish light and power to San Leandro and vicinity. A reincorporation of the Suburban Electric Light Company, which was created in 1904 with a capital stock of $500,000. Directors: Charles A. Jeffery, R. W. Geisenhofer, L. B. Smith, William Lucie, A. J. Lloyd, Jacob Harder, Jr., and J. W. Burge.

SPRINGFIELD, ILL.—Pana, Girard & Jacksonville Railroad Company. $50,000. To construct an electric road from Pana, Christian County, by way of Girard to Jacksonville, Morgan County. Incorporators and first board of directors: B. F. Darnielle, J. N. Anderson and W. F. Bercher, of Springfield; John J. Stowe, of Girard, and Charles E. Sargent, of Greenfield.

AUGUSTA, ME.—Oxford & Otisfield Telegraph and Telephone Company, Oxford. To conduct a general telephone business in the towns of Otisfield, Casco, Raymond and Harrison, in Cumberland County; Oxford, Norway and Paris, in Oxford County, and Mechanic Falls and Poland, in Androscoggin County. $5,000, of which $350 is paid in. Incorporators: H. M. Stone, James G. Howe and E. R. Stone, of East Otisfield; George B. Turner, William Faunce, L. H. Dunn, Orrin Stevens, C. H. Robinson, John E. Ordway, A. L. Marr, S. M. Patterson, E. L. Burns and George Hazen, of Oxford, and F. L. Keene, C. O. Martin and F. L. Knight, of Otisfield. H. M. Stone is president, and George B. Turner is treasurer.

INDUSTRIAL ITEMS.

THE B. F. STURTEVANT COMPANY, Hyde Park, Mass., has published bulletin No. 153, devoted to a description of its exhaust fans. Copies of this bulletin will be furnished upon request.

THE F. BISSELL COMPANY, Toledo, Ohio, will be pleased to send to any one interested a valuable little treatise on the subject of credit. This is taken from the essay entitled "Dollars and Cents," by Colonel W. C. Hunter.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., has published a very interesting bulletin devoted to electrical equipment for farms. The company will be pleased to send this bulletin to any one interested upon request.

THE HASCHKE STORAGE BATTERY COMPANY, 271 Michigan avenue, Chicago, Ill., has published a new catalogue descriptive of the Haschke electric storage batteries. These ignition batteries, the company states, will give from 2,500 to 3,500 miles with one charge.

THE H. KRANTZ MANUFACTURING COMPANY, 169 Seventh street, Brooklyn, N. Y., is distributing bulletin No. 20, devoted to standard and straight-line National Electrical Code Standard panelboards and accessories. Copies of this bulletin will be furnished upon request.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., announces that it has made the first shipment of 10,000 230-volt Columbia incandescent lamps for the new Singer Building in New York city. There will be about 25,000 lamps required. The Central Electric Company is the general western sales agent for the Okonite Company.

THE FEDERAL ELECTRIC COMPANY, Chicago, Ill., is placing on the market a very attractive device designated as the Federal tungsten cluster. These clusters are displacing gas arcs for store lighting because they cost less and are more efficient. They are easy to install and are proving very attractive for this class of service.

THE LE VALLEY-VITAE CARBON BRUSH COMPANY, 685 Tremont avenue, New York city, is distributing two very attractive advertising folders calling attention to the virtues of the LeValley-Vitae carbon brush. Samples of this literature and a set of these carbon brushes will be forwarded to those making legitimate requests.

THE GERMANIA ELECTRIC LAMP COMPANY, Newark, N. J., reports a very satisfactory increase in its sales. Among recent orders a large contract has been signed for lamps for the Singer Building, New York city. This is the eighth successive order that the Germania company has received from the owners of this building.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., gave a dinner to its selling organization at Heublein's, Hartford, Ct., on Saturday evening, April 4. The menu was unique in its get-up and was embellished by happy suggestions from L. L. Brastow, of the publicity department, and by some original poetry by Thomas D. Watson, manager of the company's New York office.

THE HABIRSHAW WIRE COMPANY, 253 Broadway, New York city, has issued a new price list covering National Electrical Code rubber-covered wires and cables, and standard rubber-insulated conductors. This book will be found of great practical value to all interested in wiring problems. In addition to the data devoted to the company's product there is considerable engineering information which may be applied to the preparation of wiring data.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., in bulletin No. 5910-4, describes power equipment for breweries. This takes up the question of individual motor-drive for breweries, and illustrates representative installations of Western Electric equipment. The company has also issued bulletin No. 5910-5, devoted to power equipments for printing offices. This shows many adaptations of Western Electric motors for driving printing office machinery.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., announces that the contract for the electric turret-turning gear of the United States ship Delaware, now under construction at Newport News, has been secured by the company. The Cutler-Hammer company designed and built the electric turret-turning gear installed in the port after-turret of the Indiana, the crew of which holds the world's record for marksmanship—ten shots in two and one-half minutes, all hits.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., is distributing pamphlet No. 5, devoted to the No. 890 iron-clad magneto telephone. This bulletin will be found of great interest to those desiring information on this class of telephone, which has been especially built for mines, for outdoor use, and for places where an instrument is subjected to the severest atmospheric and climatic conditions. Copies of this bulletin will be furnished upon request.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Cosmos Club, Washington, D. C.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis avenue, New York city.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa. Next meeting, Albany, N. Y., April 30-May 2.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth street, New York city. Meetings second Friday of each month. Annual meeting, Atlantic City, N. J., June 30-July 2.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Fifty-seventh street, New York city.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Park Row Building, New York city. Annual meeting, Atlantic City, N. J., October.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, Elmer M. White, treasurer Birmingham Railway, Light and Power Company, Birmingham, Ala.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. W. Freeman, vice-president and general manager Edison Electric Illuminating Company, Brooklyn, N. Y.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Milholland, secretary and treasurer Indianapolis Traction and Terminal Company, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Ct.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Stanlay, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau street, New York city.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York city.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. B. Cheadle, Joliet, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La. Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Van Rensselaer Lansingh, Engineering Societies Building, 33 West Thirty-ninth street, New York city.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex. Annual meeting, Dallas, Tex., May 25-27.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. S. Norton, Indianapolis, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ward, Grand Rapids, Mich.; assistant secretary, J. A. Harney, Monadnock Building, Chicago, Ill.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Dubuque, Iowa. Annual meeting, Des Moines, Iowa, April 22-23.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa. Annual meeting, Des Moines, Iowa, April 22-24.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MISSOURI STATE ELECTRIC LIGHT ASSOCIATION. Secretary, C. C. Pierson, St. Charles, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George Schweer, Windsor, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y. Next meeting, Chicago, Ill., July 15.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. W. Freeman, Engineering Societies Building, 29 West Thirty-ninth street, New York city. Annual meeting, Chicago, Ill., May 19-22.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln. Annual meeting, Omaha, Neb., May 6-7.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl street, Boston, Mass. Meetings held on fourth Thursday of every month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, R. N. Kimball, Kenosha, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio. Annual meeting, Columbus, Ohio, March 19.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, Cleveland, Ohio. Next meeting, Columbus, Ohio, May 15-16.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Annual meeting, Guthrie, May 25-27.

OLD TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKES PEAK POLYTECHNIC SOCIETY.. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa. Next meeting, New York city, May 12.

RAILWAY TELEGRAPH SUPERINTENDENTS' ASSOCIATION. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis. Next annual meeting, Montreal, Canada, June 24-26.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Annual convention, El Paso, Tex., May 7-9.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

DATES AHEAD.

Iowa Electrical Association. Annual meeting, Des Moines, Iowa, April 22-23.

Iowa Street and Interurban Railway Association. Annual meeting, Des Moines, Iowa, April 22-24.

American Electrochemical Society. Next meeting, Albany, N. Y., April 30-May 2.

Nebraska Electrical Trades Association. First annual electrical show, Auditorium, Omaha, Neb., May 4-9.

Nebraska Electrical Association. First annual meeting, Omaha, Neb., May 6-7.

West Virginia Independent Telephone Association. Annual meeting, Fairmont, W. Va., May 7-9.

Southwestern Electrical and Gas Association. Annual convention, El Paso, Tex., May 7-9.

Railway Signal Association. Next meeting, New York city, May 12.

Ohio Society of Mechanical, Electrical and Steam Engineers. Next meeting, Columbus, Ohio, May 15-16.

National Electric Light Association. Annual meeting, Chicago, Ill., May 19-22.

Telephone Association of Texas and Louisiana. Annual meeting, Dallas, Tex., May 25-27.

Oklahoma Electric Light, Railway and Gas Association. Annual meeting, Guthrie, Okla., May 25-27.

American Institute of Electrical Engineers. Annual meeting, Atlantic City, N. J., June 29-July 2.

National Electrical Contractors' Association. Next meeting, Chicago, Ill., July 15.

American Society of Municipal Improvements. Annual meeting, Atlantic City, N. J., October.

Record of Electrical Patents.

Week of March 31.

883,170. ELECTRODE FOR THE RECOVERY OF METALS FROM SOLUTIONS BY ELECTROLYSIS. Samuel B. Christy, Berkeley, Cal. A compound electrode built up of porous conducting sections.

883,181. ELECTRIC STREET-RAILWAY SWITCH. John P. Dowd and Thomas P. Dowd, Cedar Rapids, Iowa. A pair of electromagnets carried on the truck, throw the switch tongue in one direction or the other.

883,195. SYSTEM OF DISTRIBUTION. David Hall, Norwood, Ohio, assignor to the Bullock Electric Manufacturing Company. A multiple-voltage system provided with means for automatically cutting out the field windings of one of the generators.

883,200. CONTROLLER FOR ELECTRIC MOTORS. Henry D. James, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A rheostat with two circular faceplates, the contact arms of which are independently controlled by a single handle.

883,217. AUTOMATICALLY TRIPPING TROLLEY-POLE MECHANISM. Thomas H. Mars, Chicago, Ill. A catch automatically releases the supporting spring if the pole rises to an abnormal angle.

883,225. COUPLING APPARATUS FOR ELECTRIC CIRCUITS. Nicholas F. Niederlander, St. Louis, Mo., assignor to Westinghouse Automatic Air and Steam Coupler Company, St. Louis, Mo. A spring-locking coupling for electric trains.

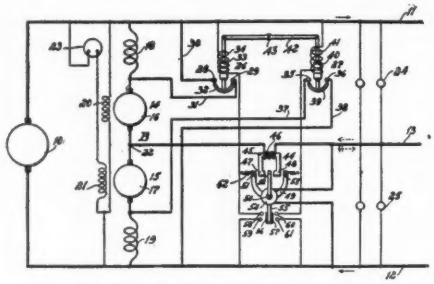
883,226. FIRE-ALARM AND SIGNAL SYSTEM. John D. Nolen, Toledo, Ohio, assignor, by mesne assignments, to John E. Shepherd, Chicago, Ill. Two sets of mechanisms are provided for controlling a pair of contacts at each signaling station.

883,227. INSULATOR. Edward F. Padden, Chicago, Ill. A pin in the support registers with a slot on the insulator body.

883,241. WIRELESS RECEIVING INSTRUMENT. Frederick G. Sargent, Westford, Mass. A coherer comprising a loose, dry, mechanical mixture of zinc and carbon.

883,242. ATTACHMENT FOR TROLLEY HARPS. William F. Savage, Columbus, Ohio. Replacing guides are provided on each side of the wheel, consisting of helically grooved, conical rollers.

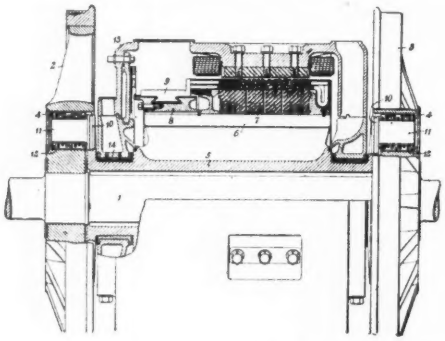
883,246. DYNAMOELECTRIC MACHINE. Robert Siegfried, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A motor for railway work, or the like, mounted on a quill slipped over the driving axle.



883,195.—System of Distribution.

883,247. SUPPORTING STRUCTURE FOR DYNAMOELECTRIC MACHINES. Robert Siegfried, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A quill and driving spider for an electric motor, the arms of the spider being short enough to slip through the hollow armature core.

883,248. SUPPORTING STRUCTURE FOR DYNAMOELECTRIC MACHINES. Robert Siegfried, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A quill and driving spiders for supporting an electric motor, the former consisting of two parts, one slipping over the other.

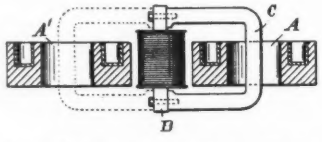


883,247.—Supporting Structure for Dynamoelectric Machines.

883,272. COMBINED FUSED CONNECTOR AND LIGHTNING ARRESTER FOR ELECTRIC WIRES. Frederick C. Woods, Galesburg, Ill. The conductor terminals are embedded in an insulating material and connected together exteriorly by a fuse.

883,276. ELECTROMAGNETIC MOTOR. Arthur H. Beard, Memphis, Tenn. Rotatory motion is secured through two electromagnets mounted upon a rocking lever.

883,310. TROLLEY HARP. Edward J. Harrison, South Bend, Ind. A harp provided with locking springs.



883,311.—Electrical Smelting Furnace.

883,311. ELECTRICAL SMELTING FURNACE. Karl A. F. Hiorth, Christiania, Norway. A combination of a number of induction-furnace hearths with one common magnetic circuit.

883,346. INDUCTOR ELECTRIC GENERATOR. Parnell Rabbidge, Neutral Bay, near Sydney, New South Wales, Australia. A rotating inductor alternately sends the magnetic flux through, or around, the coil.

883,350. COMBINATION SIGNAL AND TRAIN-STOPPING APPARATUS. Alfred L. Ruthven, Topeka, Kan. An automatic signaling and brake controlling system.

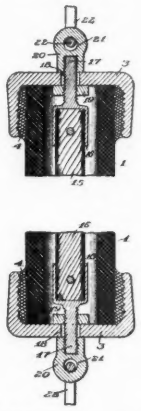
883,389. SWITCH CLIP. John Clay, New York, N. Y. A knife-switch with clips attached to the blades.

883,397. INSULATOR. Walter T. Goddard and John S. Lapp, Victor, N. Y., assignors to the Locke Insulator Manufacturing Company, Victor, N. Y. An insulator built up of two insulating tension sections of different tensile strength.

883,416. ELECTRIC ALARM FOR LOCKS. Frank M. Merrill, Los Angeles, Cal. A burglar alarm for attaching to door locks.

883,437. RECEIVER FOR SPACE-SIGNALING SYSTEMS. Leonard D. Wildman, San Francisco, Cal. Conducting surfaces in close proximity are brought into contact by the electric waves.

883,530. TELEGRAPH REPEATER. Stephen D. Field, Stockbridge, Mass. An inductance is placed in the repeater circuit and means are provided for shunting the former.



883,397.—Insulator.

883,537. HARVESTING SUGAR CANE. Henry G. Ginaca, Honolulu, Hawaii, assignor, by direct and mesne assignments, of two-fifths to Abraham Gartenberg, Honolulu, Hawaii. An electrically driven harvesting machine.

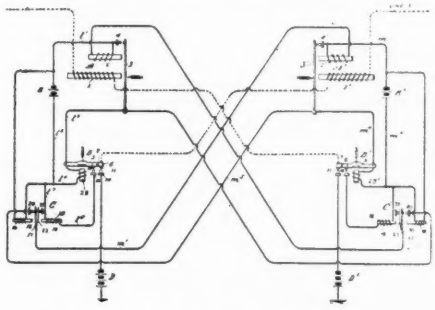
883,539. ANNUNCIATOR. Stephen J. Heinrich, Bellevue, Pa., assignor to American Electric Alarm Company, Pittsburg, Pa. An annunciator utilizing a revolvable dial.

883,549. FITTING FOR ELECTRIC CONDUITS. Allan R. Lakin, New York, N. Y. An outer box with a nipple and a cover embracing two sides.

883,550. BRUSH AND BRUSH-HOLDER FOR DYNAMOELECTRIC MACHINES. Frederick H. Loring, London, England. A rectangular brush with a taper head of circular cross-section.

883,589. ELECTROLYTIC PRODUCTION OF PURE TIN. Adolphe J. M. Thirot, Bourges, France, assignor to himself and Louis Auguste Mage, Avignon, France. Tin or its compounds are treated with boiling caustic soda to form a stannate which is purified and electrolyzed.

883,594. PROCESS OF OBTAINING METALS AND ALLOYS BY REDUCTION. Emilien Viel, Rennes, France. The ore is fed in a continuous stream through an electric arc.



883,530.—Telegraph Repeater.

883,595. APPARATUS FOR OBTAINING METALS AND ALLOYS. Emilien Viel, Rennes, France. A furnace for treating a continuous stream of ore by means of an arc deflected magnetically.

883,613. LIGHTNING ARRESTER. Henley V. Bastin, Lancaster, Ky. The choking coil is enclosed within an earthed metallic cylinder, itself enclosed within a second metallic cylinder connected to the line.

883,625. CABLE TERMINAL. Frank B. Cook, Chicago, Ill. A distributing cable terminal.

883,626. ELECTRICAL LINE-PROTECTOR. Frank B. Cook, Chicago, Ill. A combined fuse and lightning arrester.

883,651. ELECTROLYTIC PRODUCTION OF CHROMIC ACID. Max Le Blanc, Karlsruhe, Germany, assignor to Badische Anilin and Soda Fabrik, Ludwigshafen-on-the-Rhine, Germany. A chromium compound is oxidized electrolytically.